SEMINAR PAPERS

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Regional perspectives of agricultural development in India.

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The relative stagnation in the agricultural sector has had very grave consequences for our over-all development process. The growing shortage of wage-goods and agro-based industrial raw materials has not only had a cripping effect on the economic dynamics in the country; it has also resulted in a huge drain of foreign exchange and an increasing reliance on foreign assistance.

In the course of last five years we conducted several studies in some rural areas of Bihar which is the second most populous State accounting for a little over 10 per cent of India's population. The findings suggest that large majority of the rural households are poor peasant households and remain the most oppressed among the rural classes. Some of them own some cultivable land. Quite a significant number lease-in land mostly on crop sharing basis or on terms requiring labour services, but in some cases on terms requiring fixed payment either in cash or in kind. But there are many who are landless, some do not own even homestead land. Most of the poor peasant households are deficit ones in the sense that their bare minimum consumption expenditures exceed their incomes. These chronic deficit households are, therefore, forced to take consumption loans both in kind and cash from the landlords and big cultivators and big peasants who happen to be the main constituent of the rural rich. Sometimes, the stipulated rates of interest on these loans are exorbitantly high. Leave aside the loans, even the full payment of interest, often, is beyond the means of the deficit households. But the creditors also do not insist on full payment even in the long run. The rural rich use this debt obligation as also those arising out of allowance of dwelling space or some tiny bit of land for cultivation to the poor peasants, to force on the direct producers an informal bondage. Therefore, a system of unequal exchanges exists which gives the rural rich enormous economic benefits such as cheap and assured labour, better terms for leasing-out land, benefits obtained through what is known as "distress sales", aquiring the poor peasant lands almost for nothing.

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The enormous economic power, which gets concentrated in the hands of the rural rich, not only allows them to dominate overthe economic activities of the area but also makes them politically very powerful. They claim the bulk of the benefits that flow in the area either in the name of development activities of the government or for welfare of the rural poor. They pay less to the direct producers than is legally due to them. Most of the village quarrels among the poor peasants are settled by them.

They operate as the sole arbiter even in the context of distribution of relief and other essentials like sugar and kerosene oil by the government. For all practical purposes, they are the law in their areas. There are cases involving forced labour.[5]

It is mainly because of this that the landlords and big cultivators and rich peasants have developed an interest in continuation of this semi-feudal set-up which exists because the vast majority of the poor peasantry remains in perpetual 'deficit'. Economic gains arising out of this backward, predominantly semi-feudal agrarian structure has made the rural rich not enthusiastic to rapid development which, if allowed, is likely to improve the economic condition of the poor peasants who can thereby free themselves from the semi-feudal bondage. That is why the resources for development activites mostly are either wasted away or are used up in conspicuous consumption. It is this which explains the low utilisation of infrastructure meant for agricultural development and almost negligible net investment in agriculture.[6]

The two aspects which throw itself prominently in a semi-feudal situation are semi-feudal bondage and the inefficiency of the system compared to higher historical stages of production relation. One can see that not only the exploitation of poor is qualitatively different than is found in the advanced capitalist countries, but the semi-feudal setup operates as a drag on technological development. It will also be seen that the semi-feudal bondage is crucial characteristic in the context of semi-feudalism because mainly on account of this there emerges a class interest which is not only dominant in the rural belt but is also not enthusiastic to rapid development leading to waste and inefficiency in the agricultural sector. The semi-feudal bondage is caused mainly on account of the fact that vast majority of poor peasantry remains in perpetual 'deficit'. If rapid development takes place and the 'deficit' is wiped out, the rural rich are likely to loose most of the advantages which they are enjoying now. Therefore, the dominant class interest remains inimical to development.

The Indian rural senario, taken as a whole, is not very different than the situation described above. Estimates based on data available in the Nineteenth Round of the National Sample Survey for 1964-65 reveal that about 37 per cent of the rural population is 'employed at work' and about 60 per cent is not in the labour force. The remaining 3 per cent includes 'employed not at work', 'unemployed seeking work' and 'unemployed not seeking but available for work.

Out of those who are 'employed at work' only about 14 per cent work for less than six days a week, while about 78 per cent work on all the seven days in a week and about 64 per cent of the 'employed at work' work for more than 49 hours per week. Even then the per capita monthly consumer expenditure of about half of those who work for more than 49 hours per week, falls below the normative minimum. Thus, those who are poor in India are not necessarily those who work less, or do not work at all. According to the Second Agriculture Labour Inquiry Report about 80 per cent of the persons belonging to the agricultural labour households were found to be below the normative minimum. The other distinctive feature of the poor in rural India is that in nine out of fifteen major States, more than 50 per cent of households were found to be not reporting willingness (of any member) to take up regular full time employment within or outside the village from the category who were poor by any reasonable standard (table 1, column 2). The percentage was lowest in Kerala followed by Haryana and Punjab (combined) which were 36.84 and 42.18 respectively. Both the aforesaid facts taken together throw a suggestion to the effect that widespread bondage is prevelant in the context of labour process in rural India. However, it can hardly be said to be conclusive. We do not have direct evidence on bondage, collected on All-India scale. However, there are other facts which can be examined in this context.

Data on income and consumption expenditure of the weaker section of the rural society provides significantly corroborative evidences to our thesis. There are evidences to show that the consumption expenditures of the weaker section of the rural population invariably remains more than their incomes - Sometimes as high as 14 times the income. Those who are averse to drawing such uncomfortable conclusions from these, often suggest that the consumption expenditure data are always overestimates. Even if we grant this complaint about overestimation, the magnitude of overrestimates can not be so high as to rule out altogether the chronic and staggering nature of deficit thrown up by the aforesaid estimates. This forces the rural poor to take consumption loans mainly from the rural rich. The latest estimates show that there is evidence of high indebtedness among the agricultural labour households except in Assam, Kerala and Orissa (table 4, column 3). This invariably leads to debt-bondage.

The other method for enforcing bondage prevelant in Indian situation is one of leasing-out land. Leasing-out land to such households who are economically weak and hence incapable for maximising the output from leasing-in land, reduces the direct gain to the landowner though it leads to indirect

benefit in terms of enforcing an informal bondage on the poor peasants. It should be noted that in the Indian context today, the poor peasant households operating with small area of cultivable land are also economically weak households. Such evidence is available from table 5. It is evident from table 6 column 2 that percentage of households leasing-in land but cultivating less than one acre of land from amongst the households leasing-in land is fairly prevalent in rural India. It is negligible in Gujrat, Haryana and Punjab. It is cent per cent in Kerala and the second highest State is Tamil Nadu. Bihar almost touches 90 percent level. Kerala has the lowest area per agricultural holding, almost half of that in the second lowest that is West Bengal (column 4). In Kerala we also find that the highest percentage of households have got their tenancy rights recorded (column 3). These facts taken together suggests that there is weakening of such bondage in Kerala because of strong poor and middle peasant movement. This is also evident from table 7 which shows that the bulk of such holdings in Kerala, about 85 percent, is leased-in on the basis of either fixed money payment or payment of fixed quantity of produce. The second highest is Tamil Nadu with about 75 per cent such households leasing-in land on this basis. But in 11 States more than 50 per cent of such households lease-in for share of produce and other unspecified terms. There are 7 States where this exceeds 70 per cent mark. Even Ashok Rudra who lamented my generalisation about the validity of semi-feudal model (but for variations in details) for most part of rural India, accepts that some sort of bondedness among labour force in agriculture is a widespread phenomenon. "If being bonded by various obligations to a particular employer, and thereby not being the owner of free selling labour power be a characteristic feature of feudalism, then such feudalistic features continue to exist in various forms both in farms cultivated by tenants and farms cultivated by hired labourers."

The 25th Round National Sample Survey, July 1970-June 1971 divides the weaker section of the rural population of India in two categories, (1) lowest 10 per cent of cultivating households, and (2) non-cultivating labour households. We prefer to term them as (1) poor peasant households with land and (2) poor peasant households without land (table 5). This is mainly because that in view of widespread bondage prevailing in the country-side, they cannot be turned as labour households in the true sense of the term. Moreover, those who have been termed by us as "poor peasant households with land" instead of "lowest 10 per cent of cultivating households" invariably spend bulk of their time in agriculture and only in five States, i.e. Assam,

(6)

/ agriculture

Gujrat, Haryana, Punjab and Rajasthan, mandays worked on own farm to total worked in agriculture exceeded 50 per cent mark (table 5 columns 2 & 3). Moreover, in Indian context, those who neither earn their major income from / nor spend bulk of their time working for others, would be classed under poor peasantry even if they devote some time working for others in agriculture.

In course of studies conducted in Bihar, it was found that in operational terms, the loans advanced to the poor peasants were invariably like doles. It is known to both parties that it is beyond the means of the 'deficit' households to pay either the loan or the interest in full, even in the long run. Still the loans are advanced. The whole operation, in fact, involves that the poor peasant receives only the 'subsistence'. Part of it is paid in cash or kind or both. The rest is paid in terms of loan so asto enforee a debt bordage on the poor-peasantry with a view to appropriate almost the entire surplus value(which the poor peasantry might be receiving because of some assets held by them). This explains the absence of flow-equilibrium(in the operation of the credit mechanism) which is characteristic feature of capitalism. That is why in a semi-feudal set-up, loans repaid invariably remains less than loans taken and loans outstanding exceed the total value of assets of the debtors. These feature are prominantly displayed in the context of poor peasantry in other States of India also ? This goes to explain that even owning land does not improve the consumption level of the poor peasantry (table 5, columns 4 and 7). Only in Haryana and Punjab it seems that the poor peasantry enjoys a distinct advantage by owning land. In both these States the per capita consumption expenditure of those with land is more than 25 per cent higher than those without land. Bihar errs on the other side. In this case the consumption expenditure of those without land is about 29 per cent higher than those with land. This may be also due to the fact that it is not possible for the poor peasantry, saddled with debt and semi-feudal exploitation, to get even that much from self-cultivation which they would have got from working for others. Still the status enjoyed by those who own land over those without land in a semi-feudal set-up prevents such economically weak to part with land. Then, this category with land may have significant number of poor-middle peasantry who find it below their dignity to work for others. This again may cause the fall in the average value of per capita consumption expenditure. These causes are also operative in case of Kerala which shows signs of weakening of semi-feudal stranglehold.

Similarly in Haryana and Punjab which otherwise shows signs of weakening of semi-feudal institutions, we find fairly high indebtedness (table 4 column 3). But here also only a very small proportion of households show liability in kind (table 4, column 4). Moreover, in case of Punjab the high indebtedness reflects bondage but it is not of traditional type. Here it reflects advance payments which is done to attach the labourers for maintaining assured supply of labour in peak seasons.[10] It should, however, be noted that in a traditionl societies all the correlates related to any particular mode may not present itself with the same intensity, specially when the analysis is based on data which was neither designed nor collected to study the mode of production. Some of them in some States may give somewhat opposite results. Therefore, the conclusions have to be drawn after taking the things in their totality rather than getting bogged down in narrow empiricism. Similarly percentage of homegrown consumption to total consumption of foodgrains is lowest in Kerala, but it is higher in Haryana and Punjab thanother States where persistence of semi-feudal production relations is indicated (table 6, column 5).

One of the factors which operates as a drag on technological improvement in semi-feudal set-up, is the system of ownership of produced means of production (for conduct of husbandary) by poor peasants who receive only bare 'subsistence'. So they find that neither they can invest nor bring about new technology in agriculture. The decreasing number of plough per acre of operational holdings as size of operational holding increases (table 8), suggests that produced means of productionis mainly held by those who receive the bare 'subsistence' rather than those who receive the ' surplus' in rural India. There seems to have hardly any change taken in its extent between early fifties and early seventies. Tractorisation of agriculture in rural India as a whole is hardly of an order to explain away such decreasing trend in number of plough per acre of operational holding with increase in its size.

There are other evidences of wastage. There is negative correlation between percentage of net area sown to total cultivable area and average size of operational holding in twelve out of fifteen States (table 7,column 5). The exceptions are Kerala, Rajasthan and West Bengal. Percentage of utilisation of irrigation potential created by major and medium schemes in 1974-75 is more than 90 percemt only in six States (table 7, column 6). They are Andhra Pradesh, Haryana, Kerala, Orissa, Tamil Nadu and West Bengal, It is 100 per cent in Kerala, It is lowest in Assam followed by Bihar.

It will, thus, be seen that from the point of view of agricultural development, in a very general term Haryana and Punjab can be said to be a class by itself and the second best seems to be Kerala and West Bengal(table 3). The only difference between the Haryana-Punjab and Kerala-West Bengal set is that former is somewhat vaguely near to Junker model while that the latter confirms to somewhat Kulak dominated model with organised peasantry. There are some evidences of some weakening of semi-feudalistic features in West Bengal also where indebtedness is low (table 4, column 3) and less of wastage (table 7, columns 5 and 6). However, semi-feudalistic features are less weak in West Bengal than in Kerala."

All these, however, still support the thesis that the dominant aspect of mode of production in Indian agriculture, by and large, is semi-feudal, wherein the semi-feudal bondage - defined broadly in terms of economic and consequent social and political dependence of the vast bulk of poor peasantry on the landlords and the big peasantry - plays the key role in keeping the system inimical to overall devlopment.

But these are only first approximation to reality in scientific terms. We need much more data related to 'production relations' existing in the different parts of the country. Unfortunately, they are not being collected on an all-India scale. On the other hand we are collecting most of the data for different regions on all-India scale based on the concepts which are relevant mainly in the context of higher historical stages of 'production relations'. It is this limitation which has prevented us from understanding the reality of the objective conditions prevailing in the country. This has done considerable harm to our approach to planning in India. This is partly responsible for our overemphasis on investment planning models. No doubt, we also proposed measures which if implemented fully would have resulted in weakening of semi-feudalism. But as these measures were proposed more in the context of distributive and social justice rather than in the context of developmental planning, the stress on its implementation remained secondary. This is very true in the context agricultural sector for the most part of the rural India. It is really necessary to know the contradictions involved in the context of development, otherwise their resolution and, hence the overall development will remain a far cry. 'Investment' provides 'necessary condition' for development of agriculture in the Indian context but still we have hardly any idea about the 'sufficient condition.' It is in this sphere more than anywhere else that we need to co-ordinate the studies on regional agricultural development. Some such studies which have been done till now, are frightfully limited in numbers and are available for few States of India only. Moreover, in absence of these being uncoordinated studies, more often than not, they lack comparability.

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TABLE - 1

Net investment as percentage of national domestic product.

1950-51	5.1	1964-65	12.0
1955-56	9.9	1965-66	13.8
1956-57	13.0	1966-67	15.5
1957-58	9.9	1967-68	12.1
1958-59	10.8	1968-69	11.7
1959-60	10.9	1969-70	12.2
1960-61	12.6	1970-71	13.5
1961-62	10.7	1971-72	11.5
1962-63	12.3	1972-73	12.2
1963-64	12.2		

Source : Raj, K.N., "Growth and Stagnation in Indian Industrial Development", Economic and Political Weekly, Annual Number 1976, p.228-i.

TABLE - 2

	Annual rate of growth of per capita domestic product at constent prices.
First Plan Period (1951-52 to 1955-56)	1.6
Second Plan Period(1956-57 to 1960-61)	1.8
Third Plan Period (1961-62 to 1965-66)	0.7
Annual Plan Period(1966-67 to 1968-69)	2.1
Fourth Plan Period(1969-70 to 1973-74)	2.0

Source : Plan documents of planning Commission, Government of India.

TABLE - 3

Annual rate of growth of agricultural output (percentages) \ Standard deviation of fluctuations in production estimated from the three years moving average.	Low (< 7.5)	Moderate (7.5 to < 15)	High (≥ 15)
≥ 5	Haryana, Punjab		
≥ 3 to < 5	Kerala, West Bengal	Orissa, Uttar Pradesh	Gujrat, Bihar
≥ 2 to < 3	Assam, Tamil Nadu	Karnataka	Rajasthan
< 2	Andhra Pradesh	Madhya Pradesh	Maharashtra

Source : Jose, A.V., Agricultural Projection Tends in India 1956-57 to 1972-73 (memeographed).

TABLE - 4

STATES	Percentage of households not reporting willingness(of any member) to take up regular full time employment within or outside village in ~~not~~ income category below Rs.600 per annum per household.	Agriculture Labour Households	
		Percentage of households	
		Reporting liability to total households	Reporting liability in kind to total households reporting liability
(1)	(2)	(3)	(4)
Andhra Pradesh	40.44	37.86	6.84
Assam	53.85	17.88	12.14
Bihar	53.69	45.31	40.56
Gujrat	52.00	39.58	2.60
Haryana	42.18*	39.84	5.40
Karnataka	65.39	34.87	19.21
Kerala	36.84	19.42	5.92
Madhya Pradesh	63.12	34.79	18.65
Maharashtra	65.79	22.69	15.16
Orissa	46.67	20.50	42.44
Punjab	*	62.17	9.46
Rajasthan	48.98	49.97	10.25
Tamil Nadu	60.94	35.49	1.40
Uttar Pradesh	62.86	37.28	17.17
West Bengal	57.76	29.30	31.74

*Haryana and Punjab samples were combined because Punjab sample for the licence category was too small for any meaningful conclusion.

Source: Column 2 - National Sample Survey, 25th Round, July 1970- June 1971.

Columns 3 & 4 - Reserve Bank of India, All India Debt and Investment Survey 1971-72.

TABLE - 5

STATES	Poor Peasant households with land.			Poor peasant households without land.		
	%tage worked in agriculture to total mandays worked	% age worked on own farms to total mandays worked in agriculture.	% age capita monthly expenditure on consumption (Rs.)	% age worked in agriculture to total mandays worked	%age worked on own farms to total worked in agriculture	Per Capita monthly expenditure on consumption. (Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	82.85	23.98	28.03	78.16	3.46	29.51
Assam	84.02	59.23	34.61	75.95	7.36	36.89
Bihar	88.04	11.74	22.67	86.91	1.81	29.05
Gujrat	91.04	55.89	50.10	78.21	12.16	29.82
Haryana	88.86	80.79	41.25	60.33	11.40	52.96
Karnataka	90.41	30.96	20.23	84.78	0.20	25.61
Kerala	58.72	4.94	25.43	60.12	1.97	30.25
MadhyaPradesh	86.21	24.53	24.16	85.85	1.39	25.01
Maharashtra	91.40	21.33	28.44	89.76	5.66	27.46
Orissa	78.46	22.60	24.70	70.27	1.03	23.53
Punjab	94.34	82.83	47.26	75.26	2.46	36.89
Rajasthan	76.77	68.77	27.06	62.36	9.90	31.98
Tamil Nadu	67.09	31.89	27.89	75.97	2.78	24.67
Uttar Pradesh	85.12	46.18	26.94	68.82	4.53	27.51
West Bengal*	83.28	14.20	25.78	79.08	0.05	24.95

* Refers to Sub-round 1, July 1970 - September, 1970

Source: National Sample Survey, 25th Round, July 1970 - June 1971.

TABLE - 6

	Percentage of households		Area (ha) per agricultural holding	Percentage of homogrown consumption to total consumption of foodgrains
	Leasing-in land but cultivating less than one acre.	Have got their rights recorded in the context of their lease.		
(1)	(2)	(3)	(4)	(5)
Andhra Pradesh	61.11	22.22	2.51	36.17
Assam	35.71	28.57	1.47	63.99
Bihar	89.55	17.91	1.52	47.69
Gujrat	0.00	0.00	4.11	46.86
Haryana	0.00	22.23	3.77	52.47
Karnataka	20.00	0.00	3.20	43.98
Kerala	100.00	63.16	0.69	21.41
Madhya Pradesh	58.21	22.39	3.10	63.02
Maharashtra	50.00	30.00	4.28	39.05
Orissa	78.95	36.85	1.89	54.31
Punjab	0.00	20.00	2.89	46.89
Rajasthan	15.79	52.63	5.46	60.48
Tamil Nadu	95.85	20.83	1.45	30.31
Uttar Pradesh	52.50	17.50	11.58	57.94
West Bengal	50.00	22.73	1.20	53.38

Source : Columns 2 and 3 - National Sample Survey, 25th Round, Sub-round 1 July 1970 - September, 1970

Column 4 - Government of India, Ministry of Agriculture and Irrigation, All India Report on Agricultural Census 1970-71.

Column 5 - National Sample Survey, 19th Round, July 1964 - June 1965.

TABLE - 7

S T A T E S	Percentage of holdings taken land.			Correlation coefficient between % age of not area sown to total cultivable area & average size of operational holding	% age of utilisation of irrigation potential created by major and medium schemes in 1974-75
	On rent either partly or wholely by size class below 0.5 ha of operational holding to total taken on rent	Wholely on rent for Share of produce in size class below 0.5 ha	terms other than fixed produce, fixed money & share of produce in size class below 0.5 ha		
(1)	(2)	(3)	(4)	(5)	(6)
Andhra Pradesh	22.21	4.95	83.64	-.9510	90.6
Assam	28.33	1.89	74.62	-.7740	40.1
Bihar	49.54	64.80	5.22	-.6408	58.3
Gujarat	9.96	9.57	17.84	-.9884	60.3
Haryana	18.03	59.55	0.00	-.9483	96.2
Karnataka	17.57	23.67	11.96	-.9891	74.2
Kerala	49.62	0.48	14.54	-.2964*	100.0
Madhya Pradesh	18.48	5.54	70.97	-.9626	71.8
Maharashtra	13.61	N.A.	N.A.	-.9903	69.0
Orissa	18.55	34.75	17.28	-.9025	95.7
Punjab	23.69	60.65	21.18	-.9794	85.9
Rajasthan	16.65	7.36	79.67	-.5020*	87.7
Tamil Nadu	37.12	23.58	3.48	-.6557	96.3
Uttar Pradesh	46.75	N.A.	N.A.	-.9560	83.0
West Bengal	22.95	17.69	72.95	-.2795*	96.8

Source : Columns 2,3,4 and 5 - Government of India, Ministry of Agriculture and Irrigation, All India Report on Agriculture Census, 1970-71.

Column 6 - Government of India, Planning Commission, Annual Plan 1975-76.

*Not significant

**Cultivable area is defined as area of a holding excluding area under permanent pastures, other grasing lands, land under misllaneous tree crops, barren and uncultivable land, forests and area under non-agriculture use.

SPATIAL PATTERNS OF AGRICULTURAL DEVELOPMENT IN THE PUNJAB

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Three decades after the shattering experience of partition the Punjab has not only rehabilitated its economy—it has emerged as the richest state in the country. During 1974-75 the Punjab had a per capita real income (at 1960-61 prices) of Rs.496 compared with an all India average per capita income of Rs.341 only. The state of Punjab which grew at a slightly higher than national growth rate during the fifties recorded an unprecedented and phenomenal rate of growth during the later part of the sixties when the new technology in agriculture was extensively adopted in the state.

The main impetus to the growth of the Punjab economy was provided by developments in agriculture. The index of agricultural output in Punjab rose to 259.1 in 1975-76 compared with 103.84 in 1961-62. As against this, the index of agricultural production in India as a whole rose from 102.7 in 1960-61 to only 139.6 in 1975-76. Since agriculture alone contributes nearly 45 per cent to the state income, the total state income also exhibited a very high rate of growth during the period of green revolution in the late sixties (see Tables 1 and 2).

Although it is true that the growth of state income has also been very much helped by a very fast rate of growth in allied agricultural sectors and also in manufacturing, there is hardly any doubt that the process of economic growth has been initiated by major agricultural developments. The strong forward and backward linkages associated with agricultural development have helped in spreading the growth process to other sectors of the economy specially in the agro-industrial sectors and in the food processing sectors.

The main reasons for the Punjab having pioneered the process of green revolution may be listed very briefly.

Firstly, the Punjab has an old Ryotwari settlement and a traditional predominance of owner cultivators who have a stake in the betterment of their land. The partition led to the break-down of the estates of big Zamindars and distribution of land took place as a result of the land reforms legislation adopted during the fifties. Simultaneously, the consolidation of holdings was completed in the state during the mid fifties with the result that many cultivators could

Distribution of Net Domestic Product--Punjab and Rest of India (at 1960-61 Prices)

Sectors	1960-61 Income	1966-67 Income	1970-71 Income	1973-74 Income	Growth rate 1960-61 to 1973-74	Growth rate 1960-61 to 1966-67	Growth rate 1966-67 to 1970-71	Growth rate 1970-71 to 1973-74
			PUNJAB					
Primary	229.40 (55.81)	284.18 (52.87)	386.96 (54.93)	423.97 (58.91)	4.9	3.64	8.04	3.2
Secondary	71.86 (17.48)	107.87 (20.07)	136.07 (19.32)	155.20 (19.04)	6.7	7.00	5.93	4.5
Tertiary	109.81 (26.71)	145.49 (27.06)	181.38 (25.75)	208.91 (26.44)	5.1	4.80	5.66	4.8
Total Income	411.07 (100.00)	537.54 (100.00)	704.41 (100.00)	790.08 (100.00)	5.2	4.55	7.00	3.9
			REST OF INDIA					
Primary Sector	5735.60 (52.12)	6332.82 (42.64)	8389.04 (45.01)	8161.25 (42.09)	1.5	-1.0	7.1	-0.7
Secondary Sector	2477.14 (19.17)	3480.13 (23.43)	4159.93 (22.47)	4515.80 (23.29)	4.7	5.8	4.6	2.8
Tertiary Sector	3711.19 (28.72)	5037.51 (33.92)	6015.62 (32.49)	6712.06 (34.62)	4.7	5.2	4.5	3.7
Total Income	12923.93 (100.00)	14850.46 (100.00)	13514.59 (100.00)	19388.92 (100.00)	3.2	2.3	5.7	1.6

Table - 2

SECTORAL INCOME AND RATES OF GROWTH IN PUNJAB (1960-61 Prices)

Year	Agriculture	Animal Husbandry	Total Primary	Large Scale Manufacturing	Small Scale Manufacturing	Construction	Total Secondary	Transport communication	Total Tertiary	Total Income
1960-61	19630	3220	22940	1845	3016	1898	7186	1663	10981	41107
1961-62	19871	3234	23187	1969	3333	2166	7932	1796	11515	42634
1962-63	19136	3669	22868	2177	3624	2105	8438	1901	12014	43320
1963-64	19959	3874	23920	2463	3903	2518	9543	2057	12676	46139
1964-65	23284	4056	27429	2789	4196	2565	10238	2165	13566	51233
1965-66	20735	4867	25717	2891	4532	2553	10453	2303	13845	50015
1966-67	23264	5016	28418	2941	4773	2358	10787	2408	14549	53754
1967-68	27830	5335	33320	2922	5178	2383	11409	2587	15537	60266
1968-69	28553	5903	34605	3215	5566	2662	12397	2698	16216	63218
1969-70	31032	6068	37242	3429	6258	2672	13373	3024	17449	68055
1970-71	31933	6604	38696	3135	6401	3049	13607	3246	18138	70441
1971-72	33640	6971	40736	3305	6581	3125	14110	3506	19167	74013
1972-73	33751	7134	41031	3305	6294	3567	14169	3745	20213	75413
1973-74	34872	7529	42597	4017	6580	3734	15520	3934	20891	79008
Compund Annual Growth Rates for the periods*										
1960-61 to 1966-67	3.62			8.07	7.95	3.68		6.36		4.55
1966-67 to 1970-71	8.04			1.61	7.61	6.64		7.75		7.00
1970-71 to 1973-74	3.24			8.61	0.92	6.99		6.62		3.90
1960-61 to 1973-74	5.37			5.54	7.82	4.85		6.92		5.20

* Compound annual growth rates calculated by fitting an equation of the form $Y_t = Y_o (1 + r)^t$ for the periods.

now think of undertaking investment on larger chunks of land. Secondly, the Punjab had a very high proportion of area under irrigation—nearly 50 per cent of its area was irrigated during the fifties compared with an all India average of 17.5 per cent only. Today, more than 80 per cent of its area is irrigated. Thirdly, the state has played a very important role in the process of agricultural transformation in the Punjab. Government provided the necessary infrastructure like Bhakra Nangal network of canals, electricity, network of roads, grain markets and cooperative credit. It has over the years streamlined its agencies for provision of essential inputs at highly subsidised rates. Extension schemes have been taken seriously and the results of research have been spread over a large area. The state power has decisively passed in the hands of the rural rich and irrespective of their political colour, all state governments have taken positive policy measures to further the interests of rich farmers in the state. Finally, the enterprise of the Punjab peasant has also played a crucial role. The Punjab peasant once offered opportunities to better his lot through the adoption of new techniques, accepted the challenge by taking the necessary risks and brought about the agricultural breakthrough.

Although there is no macro study available for income distribution in the Punjab, there is ample evidence to suggest that the green revolution has benefited all strata of cultivators and also the landless labourers. But the gains of the green revolution have not been equitably distributed amongst all the sections of peasantry and categories of cultivators and agricultural labourers. Similarly, even though all the areas of Punjab have registered notable increases in output, there are important spatial variations in the growth process.

The main purpose of this paper is to explain and analyse the spatial pattern of level and growth of agricultural output in the Punjab at the district level.

More specifically, we will try to look at the levels of productivity per hectare in all the Punjab districts and growth of output from the period 1962-65 to 1970-73 and the decomposition of growth into area, productivity and cropping pattern components. We will also derive the levels of productivity per worker in the various districts and changes in this ratio over the period under study. An attempt will also be made to look at the comparative data for India as a whole.

Levels and Growth of Agricultural Output in the Punjab Districts

For an analysis of spatial variations in agricultural output, we have chosen district as the basic unit. We took the average of area and output of 13 crops during 1962-65 and 1970-73. The choice was made because 1962-65 are pre-green revolution years, whereas 1970-73 refers to a period when new technology had made a big headway in the state. The crops included are : rice, wheat, jowar, bajra, maize, barley, gram, groundnut, rape and mustard, sesamum, linseed, sugarcane and cotton.

To calculate growth rate and make inter-district comparisons, we have obtained the total value of agricultural output during both the sixties and the seventies by valuing the 13 crops included in our study at constant average all India 1970-73 prices. The detailed tables giving levels and growth of average area, output and productivity for the trienniums 1962-65 and 1970-73 for the 13 crops are given in Appendix III.

Table 3(a) gives the main results on levels and growth of agricultural output in the Punjab districts from 1962-65 to 1970-73. The table shows that the average productivity per hectare was Rs.1152 during 1962-65. The productivity per hectare ranged between Rs-849 to Rs.1586 during the sixties. Furthermore, 9 out of the 11 districts had productivity levels below Rs.1300 per hectare.

The average productivity increased from Rs.1152 to Rs.1761 during the seventies. All the districts recorded a big increase in their productivity levels. Consequently, 10 out of the 11 districts recorded a productivity level of higher than Rs.1300 per hectare. It may be recalled that during the sixties, there were only 2 districts which had productivity levels exceeding Rs.1300. Furthermore, 9 out of the 11 districts have recorded productivity levels exceeding Rs.1600 per hectare. During the sixties, there was not a single district where productivity exceeded that level (see Map 1 for details). The average rate of growth of productivity in the state has been 3.80 per cent per annum over this period and has ranged between 2.7 per cent in Ludhiana to 5.08 per cent in Gurdaspur.

We have also calculated changes in productivity per male worker over the period under study (Table 3(b)). It may be

Table - 3A

LEVELS AND GROWTH OF AGRICULTURAL OUTPUT IN THE PUNJAB DISTRICTS 1962-65 TO 1970-73

	1962-65			1970-73			Growth rate		
	Area under 19 crops (Hect)	Total output Rs.000	Yield Rs./Hect	Area under 19 crops (Hect)	Total output Rs.000	Yield Rs./ Hect	Area	Output	Yield
1. Ludhiana	312643 (7.89)	496081 (10.87)	1586	442000 (9.28)	939023 (11.19)	2125	4.42	8.30	3.73
2. Amritsar	394753 (9.96)	(459544 (10.07)	1164	449855 (9.44)	869868 (10.36)	1934	1.65	8.30	6.55
3. Kapurthala	104476 (2.64)	117789 (2.58)	1127	129396 (2.72)	248621 (2.96)	1921	2.71	9.79	6.89
4. Jullundur	260536 (6.57)	342517 (7.51)	1314	335183 (7.04)	622198 (7.42)	1856	3.20	7.75	4.41
5. Ferozepur	805039 (20.31)	936747 (20.53)	1163	901707 (18.93)	1658316 (19.77)	1839	1.42	7.40	5.90
6. Gurdaspur	248569 (6.27)	266761 (5.85)	1073	315233 (6.62)	546517 (6.52)	1734	3.01	9.38	6.18
7. Sangrur	476873 (12.03)	532134 (11.66)	1115	556768 (11.69)	959766 (11.44)	1724	1.96	7.65	5.60
8. Patiala	372846 (9.41)	418768 (9.18)	1123	468927 (9.84)	805100 (9.60)	1717	2.91	8.51	5.45
9. Bhatinda	618646 (15.61)	659714 (14.46)	1066	704732 (14.79)	1142719 (13.62)	1621	1.64	7.11	5.38
10. Ropar	116613 (2.94)	119391 (2.62)	1023	154873 (3.24)	209016 (2.49)	1354	3.57	7.25	3.57
11. Hoshiarpur	251966 (6.36)	214085 (4.69)	849	305500 (6.41)	387285 (4.62)	1268	2.44	7.69	5.14
Punjab Total	3962960	4563531	1152	4763740	8388429	1761	2.33	7.91	5.46

LEVEL AND GROWTH OF AGRICULTURAL PRODUCTIVITY IN THE PUNJAB DISTRICTS 1962-65 TO 1970-73

Table 3 (b)

	Output/Male Worker: 1962-65	1970-73	Growth Rate
1. Ludhiana	3567	4417	2.70
2. Amritsar	2218	2931	3.54
3. Kapurthala	2239	3402	5.37
4. Jullundur	2382	3132	3.48
5. Ferozepur	2981	3965	3.63
6. Gurdaspur	1933	2874	5.08
7. Sangrur	2641	3748	4.47
8. Patiala	2517	3608	4.60
9. Bhatinda	3035	3740	2.65
10. Ropar	1522	2158	4.46
11. Hoshiarpur	1638	2299	4.33
Punjab Total	2550	3438	3.80

stressed that the real index of progress is provided by productivity per worker because it is this that determines the level of consumption of the working force and the levels of surplus, if any. We have calculated the changes in output per male worker over the period 1962-65 to 1970-73 in order to be able to make comparisons between the sixties and the seventies. The per male worker productivity increased from Rs.2550 to Rs.3438 during the period under study. The highest productivity of Rs.4416 per male worker is recorded by Ludhiana. Productivity per worker increased at an annual rate of 3.8 per cent over the period under review. The growth rates in the districts ranged between 2.7 per cent in Ludhiana to 5.37 per cent in Kapurthala. Even in Ropar, the poorest district in the state, productivity per male worker increased from Rs.1521 in 1962-65 to Rs.2158 during the seventies. It may be mentioned here that productivity per male worker in an average Indian district comes out to be only Rs.1212 during 1970-73.

As has been mentioned earlier, the Punjab has recorded a very high rate of growth of output during the period 1962-65 to 1970-73. In value terms, its output increased from Rs.4563 mn. in 1962-65 to Rs.8388 mn. in 1970-73 that is at a compound rate of 7.91 per cent per annum. The area increased from 3.96 mn. hectares to 4.76 mn. hectares and yield from Rs.1152 to Rs.1761 per hectare during this period. This gives a rate of increase of area at 2.33 per cent and that of output at 5.46 per cent.

There are only very slight variations in the rate of growth of output in the various districts. Notably, all the Punjab districts have recorded a rate of growth exceeding Rs.7 per cent per annum. In two districts namely Kapurthala and Gurdaspur, the rate of increase has exceeded 9 per cent per annum.

However, one finds that there are important variations in the components of growth in the various districts. As noted earlier for the state as a whole, the rate of growth of output of 7.91 per cent is composed of 2.33 per cent increase in area and 5.46 per cent increase in yield. However, for some districts, the area increases are much higher and for others productivity increases predominate and vice-versa. For example, in Ludhiana, area increased at a rate of 4.2 per cent and productivity at a rate of only 3.75 per cent. At the other extreme, area increased only at a rate of 1.42 per cent in Ferozepur whereas productivity increased at a rate of 5.9 per cent per annum. Because of a very high level of productivity during the sixties, the rate of growth of

productivity in Ludhiana was only 3.73 per cent. Another district which recorded a productivity increase of less than 4 per cent was Ropar. In all the other districts, productivity increases exceeded 4 per cent per annum and for 3 districts were higher than 6 per cent per annum. It is this high rate of growth in productivity that has shifted most of the districts from middle productivity to high productivity ranges.

The rapid strides made by most of the Punjab districts in agricultural development is brought out by the following facts:

During 1962-65, there were only 48 districts out of 289 districts in India that had a productivity level exceeding Rs.1300 per hectare and only 8 of these had a growth rate exceeding 4.5 per cent. Out of these 8, only 2 districts belonged to Punjab.

During 1970-73, the number of districts whose productivity exceeded Rs.1300 per hectare increased from 48 to 70 in India. 22 of these had a growth rate exceeding 4.5 per cent. It is significant to note that 10 of these 22 high productivity, high growth districts belonged to the state of Punjab. The rest were distributed as follows:

Assam 1, Haryana 2, Karnataka 1, Tamil Nadu 2 and Uttar Pradesh 5. Thus, the Punjab has come to occupy a unique place in the hierarchy of agricultural development in India.

Decomposition of Growth in the Punjab

To calculate the percentage contribution of area, yield, cropping pattern and interaction to growth, we have decomposed total growth into its several components in various districts of Punjab. The methodology used is that of multiplicative model employed by Minhas-Vaidyanathan. It is obvious from Table 4 that a major contribution to growth has been made by increases in productivity. The highest (76 per cent) increase in productivity is recorded in the district of Amritsar, followed by Ferozepur, Hoshiarpur and Kapurthala. Interestingly enough, the lowest contribution to growth by yield is made in the districts of Ludhiana where it contributes only 39 per cent to the total increase in output. Notably, area increases have more than compensated the lower contribution to growth of output in Ludhiana. Area increase amounts to as much as 52.54 per cent in Ludhiana and only about 20 per cent

Table 4

Decomposition of Growth in the Punjab

District	Growth Rate	Area	% CONTRIBUTION TO GROWTH DUE TO Yield	Cropping pattern	Interaction
Amritsar	7.98	20.48	75.88	3.66	- 0.03
Bhatinda	6.87	23.73	50.22	19.37	6.68
Ferozepur	7.14	19.85	70.54	1.50	8.10
Gurdaspur	8.97	33.13	61.12	6.30	- 0.55
Hoshiarpur	7.41	32.50	64.32	- 0.81	3.98
Jullundur	7.46	42.20	56.80	- 5.39	6.39
Kapurthala	9.34	28.64	62.81	0.26	8.29
Ludhiana	7.98	54.25	39.08	- 3.39	10.06
Ropar	7.00	50.09	56.55	- 4.64	- 2.00
Patiala	8.17	35.08	56.66	2.78	5.49
Sangrur	7.37	26.26	61.17	- 1.97	14.55

in Ferozepur and Amritsar. In the rest of the districts, contribution made by area varies between 19 to 35 per cent. Cropping pattern changes are very important in the district of Bhatinda. Cropping pattern contributes as much as 19 per cent to total increase in growth. In the rest of the districts, the contribution of cropping pattern varies between a positive figure of 6 per cent to a negative figure of 5 per cent. Interaction is important in the districts of Ludhiana (10 per cent), Ferozepur and Kapurthala (8 per cent). In the rest of the districts, contribution to growth because of interaction is fairly insignificant.

To sum up, yield seems to have played a major role in the growth of output. Area increases although not predominant are playing a very important role along with changes in cropping pattern. It may, however, be remembered that in actual practice, the three components of growth are very much inter-related. Firstly, area has increased due to multiple cropping. Secondly, yields have recorded very substantial increases in some crops notable wheat and also maize and rice. Finally, the low yield crops like gram have been extensively replaced by the high yielding wheat during Rabi. Since cropping pattern changes

constitute an important component of growth, we will now describe some of these changes in the Punjab districts.

Cropping Pattern Changes in the Punjab

Cropping pattern changes at the state level are given in Table 5.

Taking the state as a whole, the first thing to be noted is that during Rabi, the area under wheat has increased from 1.54 mn. hectares to 2.33 mn. hectares that is by nearly 8 lakh hectares. About half of this increase is at the cost of gram. The area under gram declined from 7.74 lakh hectares to only 3.40 lakh hectares that is by 4.34 lakh hectares. The rest of the increase in wheat cultivation is because of larger areas coming into cultivation. The major change during Kharif is the emergence of rice as an important crop. The area under rice increased from 2.64 lakh hectares during 1962-65 to 4.38 lakh hectares during 1970-73 that is by 1.74 lakh hectares during the period under study. A notable thing is that area has not declined substantially for any of the Kharif crop. In fact, another Kharif crop that is maize has recorded substantial increases in area which increased from 3.66 lakh hectares in 1962-65 to 5.54 lakh hectares during 1970-73 that is by 1.87 lakh hectares. Thus, there has been a total increase of more than 3.60 lakh hectares during Kharif. Most of this is because of increase in area under double cropping. The provision of assured means of irrigation has enabled the cultivators to increase their intensity of cultivation and thus bring about this change in the cropping pattern. It may also be mentioned that increase in intensity has also led to substantial increases in the area under non-foodgrain crops also which increased by nearly 61 thousand hectares over the period under review. But one cannot say that there have been any major changes in the non-foodgrains sector except that area under groundnut has increased by 57 thousand hectares and that under rapeseed and mustard by 40 thousand hectares. There has been a marginal decrease in the area under sugarcane and also under cotton. The cropping pattern changes and the shifts to high productivity crops has resulted in a tremendous increase in total productivity from Rs.1152 per hectare to Rs.1761 per hectare. The total value of agricultural output increased from Rs.456 crores to Rs.839 crores over the period under study.

For the state as a whole, area under wheat constitutes 49 per cent of the total gross cultivated area. For none of

PUNJAB STATE PROFILE
OF CROPPING PATTERNS AND COMPONENTS OF AGRICULTURAL GROWTH

Sr. No.	Crop	Average 1962-65 Area Hect.	Yield Rs./Hect.	Output Rs.000	Average 1970-73 Area Hect.	Yield Rs./Hect.	Output Rs.000	Growth Indices Area	Yield	Output	Net increase in Area Hect.	Output Rs.000
1.	Rice	263667	1299	342671	438333	2255	988605	1.66	1.74	2.88	174666	645934
	percentage	(6.65)		(7.51)	(9.20)		(11.79)	(6.56)	(7.14)	(14.16)	(21.81)	(16.89)
2.	Wheat	1535333	1063	1632244	2333333	1863	4347952	1.52	1.75	2.66	798000	2715708
	percentage	(38.74)		(35.77)	(48.98)		(51.83)	(5.37)	(7.27)	(13.03)	(9.97)	(70.99)
3.	Jowar	4767	60	287	3567	452	1615	0.75	7.53	5.63	-1200	1328
	percentage	(0.12)		(0.01)	(0.07)		(0.02)	(-3.56)	(28.71)	(24.10)	(0.15)	(0.03)
4.	Bajra	137000	335	45889	157200	741	116583	1.15	2.21	2.54	20200	70694
	percentage	(3.46)		(1.01)	(3.30)		(1.39)	(1.73)	(10.43)	(12.36)	(2.52)	(1.85)
5.	Maize	366000	773	283070	553667	1021	565493	1.51	1.32	2.00	186667	282423
	percentage	(9.24)		(6.20)	(11.62)		(6.74)	(5.31)	(3.54)	(9.04)	(23.31)	(7.38)
6.	Ragi	-	-	-	-	-	-	-	-	-	-	-
	percentage											
7.	Barley	57333	642	36796	51560	724	37351	0.90	1.13	1.02	-5733	555
		(1.45)		(0.81)	(1.08)		(0.45)	(-1.31)	(1.51)	(0.19)	(0.72)	(0.01)
8.	Cereals	2364100	990	2340957	3537700	1712	6057599	1.50	1.73	2.59	1173600	3716642
	percentage	(59.65)		(51.30)	(74.26)		(72.21)	(5.17)	(7.09)	(12.62)	(46.56)	(97.17)
9.	Gram	774667	715	553501	340667	807	274948	0.44	1.13	0.50	-434000	-278553
	percentage	(19.55)		(12.13)	(7.15)		(3.23)	(-9.76)	(1.52)	(-8.37)	(54.20)	(7.28)
10.	Tur	-	-	-	-	-	-	-	-	-	-	-
	percentage											
11.	Pulses	774667	715	553501	340667	807	274948	0.44	1.13	0.50	-434000	-278553
		(19.55)		(12.13)	(7.15)		(3.28)	(-9.76)	(1.52)	(-8.37)	(54.20)	(7.28)
12.	Foodgrains	3138767	922	2894458	3878267	1633	6332547	1.24	1.77	2.19	739600	3438089
	Percentage	(79.20)		(63.43)	(81.41)		(75.49)	(2.68)	(7.41)	(10.28)	(92.36)	(89.88)
13.	Groundnut	111333	1532	170637	168500	1499	252627	1.51	0.98	1.48	57167	81990
	percentage	2.81)		(3.74)	(3.54)		(3.01)	(5.32)	(-0.38)	(5.03)	(7.14)	(2.14)
14.	Rapeseed & Mustard	90000	1060	95305	130333	1123	146751	1.45	1.06	1.54	40333	51446
	%age.	(2.27)		(2.01)	(2.74)		(1.78)	(4.74)	(0.78)	(5.54)	(5.04)	(1.34)

Contd...

TABLE - 5(CONTD.)

PUNJAB STATE PROFILE OF CROPPING

PATTERNS AND COMPONENTS OF AGRICULTURAL GROWTH

Sr. No.	Crop	Average 1962-65 Area Hect.	Average 1962-65 Yield Rs./Hect.	Average 1962-65 Output Rs. 000	Average 1970-73 Area Hect.	Average 1970-73 Yield Rs./Hect.	Average 1970-73 Output Rs. 000	Growth Indices Area	Growth Indices Yield	Growth Indices Output	Net increase in Area Hect.	Net increase in Output Rs. 000
15.	Sesamum	13307	935	13930	1475	931	13097	1.01	0.94	0.94	78	-833
	percentage	(0.35)		(0.31)	(0.30)		(0.16)	(0.07)	(-0.83)	(-0.77)	(0.01)	(0.02)
16.	Linseed	2537	889	2967	2207	950	2183	0.65	1.13	0.74	-1210	-784
	percentage	(0.00)		(0.01)	(0.05)		(0.03)	(-5.25)	(1.57)	(-3.76)	(0.15)	(0.02)
17.	Castorseed	-	-	-	-	-	-	-	-	-	-	-
	percentage											
18.	Oilseeds	[illegible]	1592	[illegible]	[illegible]	[illegible]	[illegible]	1.44	1.02	1.47	96338	131819
	percentage	(5.52)		(6.20)	(6.62)		(4.94)	[illegible]	(0.28)	(4.90)	(12.03)	(3.45)
19.	Sugarcane	114667	3485	399639	111902	4407	493084	0.98	1.26	1.23	-2765	93445
	percentage	(2.89)		(8.76)	(2.35)		(5.88)	(-0.30)	(2.98)	(2.66)	(0.35)	(2.44)
20.	Cotton	490667	2011	986599	458267	2506	1148321	0.93	1.25	1.16	-32400	161722
	percentage	(12.38)		(21.62)	(9.62)		(13.69)	(-0.85)	(2.79)	(1.92)	(4.05)	(4.23)
21.	Jute percentage	-	-	-	-	-	-	-	-	-	-	-
22.	Mesta -do-	-	-	-	-	-	-	-	-	-	-	-
23.	Tobacco	-	-	-	-	-	-	-	-	-	-	-
24.	Non-foodgrains	824201	2025	1669077	885374	2322	2056063	1.07	1.15	1.23	61173	386986
	percnetage	(20.80)		(36.57)	(18.59)		(24.51)	(0.90)	(1.73)	(2.64)	(7.64)	(10.12)
25.	TOTAL	3962968	1152	4563535	4763741	1761	8388610	1.20	1.53	1.84	800773	382507
	PERCENTAGE	(100.00)		(100.00)	(100.00)		(100.00)	(2.33)	(5.45)	(7.91)	(100.00)	(100.00)

the districts, the percentage area under wheat is less than 39 per cent. In some districts, for example, in Ludhiana, it constitutes as high as 55 per cent of the total cultivated area. Rice has become important in the districts of Amritsar, Kapurthala, Gurdaspur and marginally important in Patiala. In the former districts rice accounts for nearly 20 per cent of the total cultivated area, whereas in Patiala, it constitutes 16 per cent of the area under cultivation and in Hoshiarpur about 12 per cent of the area under cultivation. It is notable that it is only recently that the summer rice is being sown in the state on a big scale. The productivity in rice achieved in the state as a whole was as high as Rs.2255 per hectare--one of the highest in the country.

In most of the districts cropping pattern changes conform to the state pattern (see Table 6). Area under wheat has increased because of two reasons. Firstly, there has been a very big decline in the area under gram which has been diverted to wheat and secondly there has been increase in gross cultivated area and the increase has been devoted to wheat during Rabi. During Kharif, one finds that in the rice growing districts, it is rice which has accounted for increased available gross cropped area. Maize has also come up in a big way in the districts of Ropar, Hoshiarpur, Jullundar and Ludhiana. During Kharif, the importance of cotton has declined in the districts of Amritsar, Jullunder, Sangrur. On the other hand, cotton has either retained its position or increased its share in total cultivated area in the dry districts of Bhatinda and Ferozepur although the same cannot be said for the district of Sangrur where its share has gone down from 14 per cent of cultivated area to 10 per cent of net cultivated area. We may, therefore, sum up the cropping pattern changes on the basis of profile of cropping patterns and components of agricultural growth. There has been increase in wheat during Rabi all over the state. The main loser during Rabi is gram. Area under gram has perceptibly declined in all the districts in the state. The major gainers during Kharif are rice in some districts and maize in others and cotton in a few. The non-foodgrains do not seem to have made a great headway except for rapeseed and mustard and groundnut which for some districts are fairly important. By and large, Punjab continues to be a producer of foodgrains all over the state.

A paper by Mr. Harbans Singh Sidhu entitled "Acreage Response for Wheat in Punjab Agriculture" is appended (see Appendix I). This paper tries to explain the growth of area under wheat by making use of a Nerlovian model.

Table - 6

PROFILE OF CROPPING PATTERN

Crop	1962-65			1970-73		
	Area (Hect.) %	Output (100Rs) %	Yield Rs. Hect.	Area (Hect.) %	Output (100Rs) %	Yield Rs. Hect.
BHATINDA						
WHEAT	170,333 (27.53)	208,671 (31.63)	1,225	281,166 (39.89)	503,846 (44.09)	1,791
BAJRA	50,000 (8.08)	14,993 (2.27)	299	71,300 (10.11)	53,498 (4.68)	750
GRAM	234,333 (37.87)	147,141 (22.30)	627	128,066 (18.17)	87,400 (7.64)	682
COTTON	112,826 (18.23)	236,034 (35.77)	2,092	145,233 (20.60)	386,462 (33.81)	2,660
TOTAL	618,646 (100.00)	659,714 (100.00)	1,066	704,791 (100.00)	1142,719 (100.00)	1,621
ROPAR						
WHEAT	36.333 (31.15)	28,726 (24.06)	790	60,333 (39.08)	88,888 (42.52)	1,473
MAIZE	27,333 (23.43)	24,003 (20.10)	878	39,666 (25.69)	30,058 (14.38)	757
GRAM	25,000 (21.43)	15,074 (12.62)	602	19,333 (12.52)	18,024 (8.62)	932
G. NUT	5,023 (4.30)	6,758 (5.66)	1,345	11,633 (7.53)	13,647 (6.52)	1,173
SUGARCANE	10,333 (8.86)	29,998 (25.12)	2,903	9,606 (6.22)	39,998 (19.13)	4,163
TOTAL	116.613 (100.00)	119.391 (100.00)	1,023	154,372 (100.00)	209,016 (100.00)	1,353
HOSHIARPUR						
RICE	29,000 (11.50)	24,338 (11.36)	839	36.000 (11.78)	75,333 (19.45)	2,092

Table 6 continued

WHEAT	97,333 (38.62)	67,208 (31.39)	690	147,000 (48.11)	191,327 (49.40)	1,301
MAIZE	50,666 (20.10)	52,116 (24.34)	1,028	79,000 (25.85)	68,983 (17.81)	873
BAJRA	14,000 (5.55)	7,042 (3.28)	503	666 (0.21)	554 (0.11)	681
GRAM	38,000 (15.08)	26,872 (12.55)	707	25,000 (8.18)	23,267 (6.00)	930
SUGARCANE	10,666 (4.23)	26,205 (12.24)	2,456	7,566 (2.47)	18,619 (4.80)	2,460
TOTAL	251,966 (100.00)	214,085 (100.00)	849	305,499 (100.00)	387,284 (100.00)	1,267
SANGRUR						
RICE	7,666 (1.60)	12,362 (2.32)	1,612	14,000 (2.51)	30,519 (3.17)	2,179
WHEAT	179,666 (37.67)	184,552 (34.68)	1,027	287,900 (51.54)	557,992 (58.13)	1,944
BAJRA	29,000 (6.08)	7,496 (1.40)	258	33,666 (6.04)	26,124 (2.72)	775
MAIZE	36,333 (7.61)	24,003 (4.51)	660	68,666 (12.33)	79,579 (8.29)	1,158
GRAM	113,333 (23.76)	85,859 (16.13)	757	43,666 (7.84)	37,686 (3.92)	863
SUGARCANE	10,333 (2.16)	39,308 (7.38)	3,804	11,133 (1.99)	60,687 (6.32)	5,450
COTTON	68,650 (14.39)	138,793 (26.08)	2,021	56,000 (10.05)	113,930 (11.87)	2,034
TOTAL	476,873 (100.00)	532,134 (100.00)	1,115	556,768 (100.00)	959,766 (100.00)	1,723
PATIALA						
RICE	34,000 (9.11)	44,041 (10.51)	1,295	74,666 (15.92)	167,665 (20.82)	2,245
WHEAT	148,666 (39.87)	163,414 (39.02)	1,099	250,666 (53.45)	408,399 (50.72)	1,629

Table 6 continued

MAIZE	35,333 (9.47)	20,759 (4.95)	587	42,666 (9.09)	40,871 (5.07)	957
GRAM	71,666 (19.22)	50,467 (12.05)	704	27,666 (5.89)	26,544 (3.29)	959
G.NUT	19,303 (5.17)	27,666 (6.60)	1,433	27,333 (5.82)	50,023 (6.21)	1,830
TOTAL	372,846 (100.00)	418,768 (100.00)	1,123	468,926 (100.00)	805,099 (100.00)	1,716
JULLUNDUR						
RICE	8,333 (3.19)	11,976 (3.49)	1,437	22,333 (6.66)	52,926 (8.50)	2,369
WHEAT	125,666 (48.23)	145,527 (42.48)	1,158	188,000 (56.08)	371,543 (59.71)	1,976
MAIZE	51,333 (19.70)	47,358 (13.82)	922	74,666 (22.27)	81,526 (13.10)	1,091
GRAM	29,666 (11.38)	25,561 (7.46)	861	3,333 (0.99)	4,260 (0.68)	1,278
G.NUT	10,843 (4.16)	15,774 (4.60)	1,454	22,133 (6.60)	34,018 (5.46)	1,536
COTTON	13,943 (5.35)	25,613 (7.47)	1,836	7,666 (2.28)	12,704 (2.04)	1,657
TOTAL	260.536 (100.00)	342.517 (100.00)	1,314	335,182 (100.00)	622,198 (100.00)	1,856
FEROZPUR						
RICE	40,000 (4.96)	56,403 (6.02)	1,410	71,666 (7.93)	178,482 (10.76)	2,493
WHEAT	321,333 (39.91)	295,662 (31.56)	920	423,166 (46.92)	765,796 (46.17)	1,809
MAIZE	28,000 (3.47)	17,299 (1.84)	617	45,000 (4.99)	37,670 (2.27)	837

Table 6 continued

GRAM	163,000 (20.24)	112,731 (12.03)	691	78,600 (8.71)	57,447 (3.46)	730
R. MUSTARD	20,316 (2.59)	21,215 (2.26)	1,014	32,600 (3.61)	40,222 (2.42)	1,233
COTTON	172,386 (21.40)	380,997 (10.07)	2,204	177,366 (19.67)	498,753 (30.07)	2,811
TOTAL	805,089 (100.00)	936,747 (100.00)	1,163	901,706 (100.00)	1658,316 (100.00)	1,839
GURDASPUR						
RICE	53,666 (21.59)	72,242 (27.08)	1,346	81,333 (25.80)	156,075 (28.55)	1,918
WHEAT	111,000 (44.65)	94,303 (35.35)	849	148,333 (47.05)	248,508 (45.47)	1,675
GRAM	18,000 (7.24)	14,091 (5.28)	782	4,000 (1.26)	4,915 (0.89)	1,228
SUGARCANE	14,666 (5.90)	52,411 (19.64)	3,573	20,842 (6.61)	89,996 (16.46)	4,318
TOTAL	248,569 (100.00)	266,761 (100.00)	1,073	315,238 (100.00)	546,517 (100.00)	1,733
LUDHIANA						
RICE	1,666 (0.53)	2,704 (0.54)	1,622	8,333 (1.88)	20,861 (2.22)	2,503
WHEAT	131,666 (42.11)	215,175 (43.37)	1,634	242,000 (54.75)	622,762 (66.30)	2,573
MAIZE	47,333 (15.13)	44,331 (8.93)	936	90,000 (20.36)	117,423 (12.50)	1,304
GRAM	36,000 (11.51)	33,754 (6.80)	937	4,000 (0.90)	4,587 (0.48)	1,146
G.NUT	44,633 (14.27)	75,738 (15.26)	1,696	60,033 (13.58)	81,834 (8.71)	1,363

Table 6 continued

COTTON	33,830 (10.82)	73,289 (14.77)	2,166	23,333 (5.27)	46,719 (4.97)	2,002
TOTAL	312,643 (100.00)	496,031 (100.00)	1,586	442,000 (100.00)	939,203 (100.00)	2,124
AMRITSAR						
RICE	63,333 (16.80)	84,219 (18.32)	1,269	92,666 (20.59)	213,251 (24.51)	2,301
WHEAT	153,333 (40.61)	179,403 (39.03)	1,118	239,000 (53.12)	470,459 (54.08)	1,968
GRAM	41,333 (10.47)	38,669 (8.41)	935	7,000 (1.55)	10,814 (1.24)	1,544
R.MUSTARD	13,766 (3.48)	20,095 (4.37)	1,459	30,933 (6.87)	37,410 (4.30)	1,209
COTTON	43,588 (11.04)	58,012 (12.62)	1,331	18,333 (4.07)	38,933 (4.47)	2,123
TOTAL	394,753 (100.00)	459,544 (100.00)	1,164	449,854 (100.00)	869,867 (100.00)	1,933
KAPURTHALA						
RICE	16,666 (15.95)	24,724 (20.99)	1,483	28,000 (21.63)	74,947 (30.14)	2,676
WHEAT	53,000 (50.72)	49,593 (42.10)	935	66,666 (51.52)	118,427 (47.63)	1,776
G.NUT	8,170 (7.81)	11,836 (10.04)	1,448	14,166 (10.94)	24,986 (10.05)	1,763
TOTAL	104,476 (100.00)	117,789 (100.00)	1,127	129,396 (100.00)	248,621 (100.00)	1,921

Determinants of Agricultural Levels and Growth

We have not undertaken a thorough analysis of the determinants of levels of productivity in the Punjab districts. A preliminary exercise based on a multiple regression model that included several explanatory variables like irrigation, fertilisers, labour, capital etc. failed to give satisfactory results because of high level of multicollinearity. A regression model that tries to explain determinants of crop-wise productivity of wheat and rice is given in Appendix II. An indicative analysis has been undertaken by looking at the levels of productivity and the levels of input use in the various districts of the state (see table 7). Similarly, we have also tried to correlate the growth rate of agricultural output in the various Punjab districts with the levels of use of modern inputs like fertilisers, tractors, tubewells etc. It is obvious that it is the very high use of modern inputs that has enabled the Punjab districts to achieve high levels of productivity.

For example, it is interesting to note that the percentage of gross irrigated area to gross cultivated area is 76 per cent for the Punjab compared with an all India average figure of 29.93 per cent. Except for the hilly districts of Ropar, Hoshiarpur and Gurdaspur where the percentage of irrigated area to total area varies from 36 to 56, the gross irrigated area constitutes as high as 75 to 80 per cent of total area in all the other districts. The number of tractors per thousand hectares is as high as 10 in the Ludhiana and 12 in Jullundur, the lowest figure of 4 being in Ropar. This should be compared with an all India average of nearly one tractor per thousand hectares. Similarly, on the average, there are 56 tubewells and pump sets per thousand hectares of land in the Punjab. For the country as a whole, this average works out to be 25.57. The number of tubewells varies from a minimum of 29 in Bhatinda to a maximum of 118 in Kapurthala. The use of fertilisers is also very high. On the average, 47 kilograms of fertilisers are being used on each hectare of land in the Punjab. There use varies from a minimum of 28 kgs. in Bhatinda to a maximum of 81 kg./hectare in Ludhiana. This is also several times higher than the all India average of 17 kg./hectare.

It should be obvious from the above that it is the utilisation of high doses of modern inputs that has enabled the Punjab farmers to achieve a very high level of productivity. Availability of irrigation has enabled them to simultaneously undertake multiple cropping thus increasing the gross cultivated area through more intensive cultivation. It is in

State/ District.	Input & Output	G.C.A. (Hect.)	Total Area (19 crops)	% of I.A. of 19 Crops to G.C.A.	Total output (000 Rs)	Per Hect. productivity (Rs/Hect.)	Gross Irrigated Area (Hect)	% of C.I.A. to G.C.A.	Tractors (no.)
1	2	3	4	5	6	7	8	9	10
1. LUDHIANA		507667	442,000 (9.28)	87.06	939,023 (11.19)	2125	425,267 (9.67)	83.77	5079 (11.01)
2. AMRITSAR		587000	449,855 (9.44)	76 64	869,868 (10.36)	1934	556,000 (12.65)	94.72	4611 (10.00)
3. KAPURTHALA		154333	129,396 (2.72)	83.84	248,621 (2.96)	1921	128,033 (2.91)	82.96	1341 (2.91)
4. JULLUNDUR		411333	335,183 (7.04)	81.49	622,198 (7.42)	1856	343,000 (7.80)	83.39	5017
5. FEROZPUR		1113320	901,707 (18.93)	80.99	1658,316 (19.77)	1839	904,433 (20.57)	81.24	9038 (19.60)
6. GURDASPUR		368667	315,239 (6.62)	85.51	546,517 (6.52)	1734	208,267 (4.74)	56.49	2146 (4.65)
7. SANGRUR		658000	556,768 (11.69)	84.62	959,766 (11.44)	1724	550,567 (12.52)	83.67	4349 (9.43)
8. PATIALA		560000	468,927 (9.84)	83.74	805,100 (9.60)	1717	404,867 (9.21)	72.30	4738 (10.27)
9. BHATINDA		857681	704,792 (14.79)	82.17	1142,719 (13.62)	1621	666,300 (15.15)	77.69	5143 (11.15)
10. ROPAR		188000	154,373 (3.24)	82.11	209,016 (2.49)	1354	677,67 (1.54)	36.05	778 (1.69)
11. HOSHIARPUR		371667	305,500 (6.41)	82.20	387,285 (4.62)	1268	142,267 (3.24)	38.28	3877 (8.41)
PUNJAB TOTAL		5777667	4763,740 (100.00)	82.45	8388,429 (100.00)	1761	4396,768 (100.00)	76.10	46117 (100.00)

Figures in parenthesis are reporting %age to total Punjab.

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PUNJAB:

LEVEL OF AGRICULTURAL OUTPUT AND INPUTS IN THE DISTRICTS OF PUNJAB 1970-73

State/ Distt.	Per '000' Hect. of G.C.A. No. of Tract.	Tube Wells & Pumping sets.	Per '000' Hect. of G.C.A. No. of TW & P.S.	Fertiliser Consumption NPK (Tonns)	Per Hect. of amount of Fertilizer (Kgs.)	N.A.S.
1	11	12	13	14	15	16
1. LUDHIANA	10004	50,472 (15.47)	99.419	41,359 (15.31)	81.469	319,000
2. AMRITSAR	7855	29,131 (8.93)	49.627	32,816 (12.15)	55,905	390,667
3. KAPURTHALA	8689	18,286 (5.60)	118.484	10,394 (3.85)	67.348	131,667
4. JULLUNDUR	12197	34,226 (10.49)	83.207	29,614 (10.96)	71.995	285,667
5. FEROZPUR	8118	37,698 (11.55)	33.861	43,840 (16.23)	39.378	843,256
6. GURDASPUR	5821	15,106 (4.63)	40.975	18,213 (6.74)	49.402	258,000
7. SANGRUR	6609	44,929 (13.77)	68.281	25,133 (9.30)	38.196	449,000
8. PATIALA	8461	38,992 (11.95)	69.929	25,942 (9.60)	46.325	385,667
9. BHATINDA	5996	25,107 (7 .69)	29.273	24,295 (8.99)	28.326	638,411
10 ROPAR	4138	7,945 (2.43)	42.261	6,638 (2.46)	35.308	120,000
11. HOSHIARPUR	10431	24,439 (7.49)	65.755	11,941 (4.42)	32.128	250,333
PUNJAB TOTAL	7982	326,331 (100.00)	56.481	270,185 (100.00)	46.764	4071,667

Figures in parenthesis are reporting %age to total Punjab.

respect of modernisation that the Punjab agriculture differs from agriculture in most other parts of the country. Irrigation level being fairly high even during the sixties, the increases in productivity can be attributed to use of modern inputs like fertilisers, pesticides etc.

Summing Up

In this paper, we have tried to analyse the success story of Punjab agriculture during the period 1962-65 to 1970-73. The Punjab experience is unique since most of the Punjab districts belong to the category of 22 / very high growth and very high productivity districts in India. The rate of growth in each district has exceeded 7 per cent per annum. In this respect, there has been very little regional variations. However, there are regional variations in the levels of productivity per hectare as well as productivity per worker. Ludhiana was and continues to be the richest and Ropar still is the poorest district. One also discovers regional variations at the district level in terms of prevailing cropping pattern. The districts in Doaba along with Amritsar and Gurdaspur are becoming important in rice production during Kharif in addition to being important wheat producers. The dry districts of Bhatinda and Ferozepur generally grow cotton in addition to wheat. There have also been important differences in the components of growth in the various districts. In general, it is productivity per hectare which is the main cause of growth of output. But in some districts specially in Ludhiana area increases are also quite important.

It has not been possible to quantify the main determinants of agricultural levels and growth in the Punjab. But the data does bring out the fact that in all districts, the use of modern inputs increased at a very fast rate. This, of course, was made possible because of the availability of irrigation. But obviously the growth of agricultural output in Punjab seems to be a direct consequence of adoption of new technology in agriculture on a wide scale.

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Appendix I

ACREAGE RESPONSE FOR WHEAT IN PUNJAB AGRICULTURE BY Mr. HARBANS SINGH SIDHU : TERM PAPER SUBMITTED IN PARTIAL FULFILMENT FOR THE REQUIREMENT OF M.Phil. COURSE No. 914 (AGRICULTURE IN REGIONAL DEVELOPMENT —MONSOON SEMESTER 1976-77, CENTRE FOR THE STUDY OF REGIONAL DEVELOPMENT, JAWAHARLAL NEHRU UNIVERSITY, NEW DELHI-110057

The Model

The basic model is Nerlovian adjustment model.

where

A	Area under wheat crop in thousand hectares;
P	Ratio of price of wheat crop to that of competing crop i.e. gram;
Y	Ratio of yield of wheat to that of the competing crop gram;
Z	Area irrigated under wheat;
R	Annual rainfall in millimeters; and
t	Time period.

Yield and price have been taken with a log because farmers make the decisions from their past experience rather than from the future expectations. Similarly, area irrigated under wheat has also been taken with a log because it is seen that a larger proportion of area is irrigated through canals. Therefore, farmer is supposed to take into consideration the previous years availability of water. Whereas the rainfall has been taken of the same year because winter crop like wheat, gram etc. are planted from the middle of October onwards in Punjab and their acreage is influenced in part by moisture left in the field by the monsoon.

Results and Discussion

Step regression was run for the above model. The first variable to enter was area irrigated under wheat. It was positive and significant. Next to enter were rainfall and yield. These two variables had positive sign but were not

significant. Fourth to enter was price and it obtained the wrong sign and was not significant. So in the second exercise, price was dropped and was replaced by lagged value of the dependent variable. But it not only turned out to be insignificant but also reduced the significance of other explanatory variables. So in the final exercise price and lagged dependent variable both were dropped and the equation re-estimated. The results were as follows:

It can be seen that the relative yield and rainfall have positive signs but both are insignificant. But the most important factor explaining this area shift turned out to be irrigation.

The interpretation of the above results would be as follows. Expansion of net area irrigated and hence irrigated area under wheat has been an important factor throughout the period while relative yield changes have probably been not so important. This means the shift out of gram would have continued even if high yielding varieties of wheat were not introduced. This is because given that the yield of irrigated wheat is higher than that of gram, an increase in irrigated area would cause shift of area into wheat and yield changes would emerge as a consequence of this rather than be a cause of this shift.

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* Figures in the parenthesis are the T-values.

Appendix II

DETERMINANTS OF CROP-WISE PRODUCTIVITY

We have also tried to find out the factors that could be considered as most important for explaining crop-wise output and productivity. Taking wheat, the following models were fitted:

i) O is a function of IA

ii) $\frac{O}{A}$ is a function of $\frac{IAW}{TAW}$

where O is output of wheat in the district;
A is total area of wheat in the district;
IAW is irrigated area of wheat in the district; and
TAW is the total area of wheat in the district.

The results are summarised in the Table below:

Double Log Function

Regression coefficient	T values	R	F value
		Wheat	
.949 (.074)	12.74	.953	12.74
.721* (.212	3.40	.77	11.58
		Rice	
.982 (.0182)	53.71	.99	84.85
.735 (.138)	5.31	.758	28.20

* Significant at 5 per cent level.

The double log function gives a very high value of correlation coefficient for irrigation both for output as

well as productivity indicating that the main explanatory variable for these happens to be irrigation.

Similar functions were fitted for rice. In this case also both for output as well as productivity, irrigation seems to be explaining most of the variation in the levels of productivity.

It may be pointed out that irrigation in these two cases is capturing the effects of all other variables like fertilisers etc. Since cropwise information on fertiliser use is not available, it was not possible to introduce these variables explicitly. Consequently, irrigation becomes a proxy variable for several other things.

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APPENDIX - III

RICE LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT & PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

SR, No.	State/District	Average for 1962-63, 1963-64, 1964-65 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	Average for 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	C/O ANN. COMP. GROWTH RATE 1970-73 OVER 1962-65. AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	66333.	72666.	1095.	92666.	184000.	1986.	4.27	12.31	7.72
2.	BHATINDA	333.	333.	1000.	2766.	5666.	2048.	30.23	42.50	9.38
3.	FEROZPUR	40000.	48666.	1217.	71566.	154000.	2152.	7.54	15.49	7.39
4.	GURDASPUR	58666.	62333.	1061.	81333.	134666.	1656.	5.33	10.11	4.53
5.	HOSHIARPUR	29000.	21000.	724.	36000.	66000.	1803.	2.74	15.17	12.10
6.	JULLUNDUR	8333.	10333.	1240.	22333.	45666.	2044.	13.11	20.41	6.45
7.	KAPURTHALA	16666.	21333.	1280.	28000.	64666.	2310.	6.70	14.87	7.66
8.	LUDHIANA	1666.	2333.	1400.	8333.	18000.	2160.	22.23	29.10	5.57
9.	ROPAR	6000.	8000.	1333.	6666.	10333.	1550.	1.33	3.25	1.90
10.	PATIALA	34000.	38000.	1118.	74666.	144666.	1938.	10.38	18.19	7.12
11.	SANGRUR	7666.	10666.	1391.	14000.	26333.	1881.	7.82	11.96	3.84
	PUNJAB	263667.	295667.	1121.	433333.	853000.	1946.	6.56	14.16	7.15

WHEAT

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

SR. NO.	STATE/DISTRICT	Average for 1962-63, 1963-64, 1964-65 (AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	Average for 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	% C/O ANN. COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	160333.	220666.	1376.	289000.	578666.	2421.	5.12	12.31	7.32
2.	BHATINDA	270333.	356666.	1307.	331166.	619733.	1894.	3.47	11.65	4.87
3.	FEROZPUR	321333.	368666.	1138.	482166.	841933.	2223.	5.50	12.63	8.82
4.	GURDASPUR	111000.	116000.	1045.	143333.	305666.	2131.	3.09	12.88	8.86
5.	HUSHIARPUR	97233.	128666.	849.	147000.	285333.	1801.	5.23	13.97	8.25
6.	JULLUNDUR	125666.	179000.	1424.	188000.	457000.	2437.	5.19	12.43	6.91
7.	KAPURTHALA	53000.	61000.	1151.	69666.	145666.	2185.	8.91	11.49	8.34
8.	LUDHIANA	131666.	264666.	2010.	242000.	766000.	3168.	7.91	14.21	5.84
9.	ROPAR	96333.	95333.	972.	60333.	109333.	1812.	6.54	15.17	8.09
10.	PATIALA	148666.	201000.	1352.	250666.	502333.	2004.	6.75	12.13	5.01
11.	SANGRUR	179666.	227000.	1263.	287000.	686333.	2391.	6.03	14.83	8.30
	PUNJAB	1535333.	2007667.	1308.	2333333.	5348000.	2292.	5.37	13.03	7.26

JOWAR

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

SR. No.	State/District	Average for 1962-63, 1963-64, 1964-65			Average for 1970-71, 1971-72, 1972-73			O/O ANN. COMP. GROWTH RATE 1970-73 OVER 1962-65		
		AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	0.	0.	0.	0.	0.	0.	0.00	0.00	0.00
2.	BHATINDA	666.	333.	500.	266.	266.	1000.	-10.81	-2.74	9.05
3.	FEROZPUR	1666.	0.	0.	1266.	766.	605.	- 3.36	0.00	0.00
4.	GURDASPUR	1333.	0.	0.	66.	0.	0.	-31.22	0.00	0.00
5.	HOSHIARPUR	666.	0.	0.	66.	33.	500.	-25.00	0.00	0.00
6.	JULLUNDUR	0.	0.	0.	66.	0.	0.	0.00	0.00	0.00
7.	KAPURTHALA	0.	0.	0.	0.	0.	0.	0.00	0.00	0.00
8.	LUDHIANA	0.	0.	0.	366.	200.	545.	0.00	0.00	0.00
9.	ROPAR	100.	0.	0.	100.	33.	333.	0.00	0.00	0.00
10.	PATIALA	0.	0.	0.	933.	533.	571.	0.00	0.00	0.00
11.	SANGUR	333.	33.	100.	433.	233.	538.	3.33	27.54	23.42
	PUNJAB	4767.	367.	77.	3567.	2067.	579.	- 3.55	-24.13	28.62

JOWAR

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

SR. No.	State/District	Average for 1962-63, 1963-64, 1964-65 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	Average for 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	C/O ANN. COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	0.	0.	0.	0.	0.	0.	0.00	0.00	0.00
2.	BHATINDA	666.	333.	500.	266.	266.	1000.	-10.81	-2.74	9.05
3.	FEROZPUR	1666.	0.	0.	1266.	766.	605.	- 3.36	0.00	0.00
4.	GURDASPUR	1333.	0.	0.	66.	0.	0.	-31.22	0.00	0.00
5.	HOSHIARPUR	666.	0.	0.	66.	33.	500.	-25.00	0.00	0.00
6.	JULLUNDUR	0.	0.	0.	66.	0.	0.	0.00	0.00	0.00
7.	KAPURTHALA	0.	0.	0.	0.	0.	0.	0.00	0.00	0.00
8.	LUDHIANA	0.	0.	0.	366.	200.	545.	0.00	0.00	0.00
9.	ROPAR	100.	0.	0.	100.	33.	333.	0.00	0.00	0.00
10.	PATIALA	0.	0.	0.	933.	533.	571.	0.00	0.00	0.00
11.	SANGUR	333.	33.	100.	433.	233.	538.	3.33	27.54	23.42
	PUNJAB	4767.	367.	77.	3567.	2067.	579.	- 3.55	-24.13	28.62

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY
FOR THE TRIENNIUMS 1962-65 & 1970-73

BAJRA

PAGE 65

SR. NO.	STATE/DISTRICT	Average for 1962-63, 1963-64, 1964-65 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	Average of 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	O/O ANN. COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	7666.	5000.	652.	5666.	5000.	882.	- 3.70	0.00	3.85
2.	BHATINDA	50000.	22000.	440.	71300.	78500.	1101.	4.54	17.23	12.15
3.	FEROZPUR	28666.	15666.	547.	37500.	39500.	1052.	3.41	12.25	8.55
4.	GURDASPUR	2666.	1666.	625.	3000.	2666.	889.	1.48	6.05	4.50
5.	HOSHIARPUR	14000.	10333.	738.	666.	666.	1000.	-31.64	-29.00	3.87
6.	JULLUNDUR	1000.	333.	333.	33.	[illegible]	1000.	-34.62	-25.00	14.72
7.	KAPURTHALA	333.	333.	1000.	0.	0.	0.	-99.99	-99.99	-99.99
8.	LUDHIANA	666.	333.	500.	1033.	1033.	1000.	5.63	15.19	9.05
9.	ROPAR	0.	0.	0.	0.	0.	0.	0.00	0.00	0.00
10.	PATIALA	3000.	666.	222.	4333.	5333.	1231.	4.70	29.68	23.86
11.	SANGRUR	29000.	11000.	379.	33666.	38333.	1139.	1.88	16.89	14.73
	PUNJAB	137000.	67334.	491.	157200.	171067.	1088.	1.73	12.36	10.44

MAIZE

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT & PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

PLAN 12

Sr.No.	State/District	Average ø for 1962-63, 1963-64, 1964-65 (Area) (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	Average for 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	O/O ANN. COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	42666.	41000.	961.	42000.	71000.	1690.	- .19	7.10	7.32
2.	BHATINDA	8666.	6000.	692	20000.	32266.	1613	11.02	23.40	11.15
3.	FEROZPUR	28000 .	26666.	952.	45000.	58066.	1290.	6.11	10.22	3.87
4.	GURDASPUR	25000.	22666 .	907	36000.	39666.	1102.	4.66	7.25	2.47
5.	HOSHIARPUR	50666.	80333.	1586.	79000.	106333.	1346.	5.71	3.37	-2.02
6.	JULLUNDUR	51333.	73000.	1422.	74666.	125666.	1683.	4.80	7.03	2.13
7.	KAPURTHALA	13333.	12333.	925.	16000.	25666.	1604.	2.31	9.59	7.12
8.	LUDHIANA	47333.	68333.	1444.	90000.	181000.	2011.	8.36	12.95	4.23
9.	ROPAR	27333.	37000.	1354.	39666.	46333.	1168.	4.77	2.85	-1.82
10.	PATIALA	35333.	32000.	906.	42666.	63000.	1477.	2.39	8.84	6 .30
11.	SANGRUR	36333.	37000.	1018.	68666.	122666.	1786.	8.28	16.16	7.28
	PUNJAB	366000.	436333.	1192.	553667.	871667.	1574.	5.31	9.04	3.54

BARLEY

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

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SR. NO.	STATE/DISTRICT	AVERAGE FOR 1962-63, 1963-64, 1964-65 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	AVERAGE FOR 1970-71, 1971-72-1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	O/O ANN. COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	3000.	3666.	1222.	1333.	1666.	1250.	- 9.63	9.38	.28
2.	BHATINDA	6666.	6333.	950.	6400.	7033.	1099.	- .50	1.32	1.84
3.	FEROZPUR	20666	20333.	984.	24866.	26966.	1084.	2.34	3.59	1.22
4.	GURDASPUR	8333.	6333.	760.	5333.	5000.	938.	- 5.42	-2.90	2.66
5.	HOSHIARPUR	1000.	1000.	1000.	0.	0.	0.	-99.99	-99.99	-99.99
6.	JULLUNDUR	0.	0.	0.	0.	0.	0.	0.00	0.00	0.00
7.	KAPURTHALA	1000.	666.	667.	333.	333.	1000.	-12.82	-8.29	5.20
8.	LUDHIANA	3333.	4000.	1200.	2333.	3333.	1429.	- 4.35	-2.24	2.20
9.	ROPAR	1000.	333.	333.	1000.	1500.	1500.	0.00	20.68	20.68
10.	PATIALA	7333.	7000.	955.	4000.	3666.	917.	7.29	-7.75	-.49
11.	SANGRUR	5000.	5666.	1133.	6000.	6666.	1111.	2.31	2.05	-.24
	PUNJAB	57333.	55333.	965.	51600.	56167.	1089.	-1.30	.19	1.51

GRAM

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

PAGE NO

SR.No.	STATE/DISTRICT	Average for 1962-63, 1963-64, 1964-65 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	Average for 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	O/O ANN.COMP.GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	41333.	39333.	952.	7000.	11000.	1571.	-19.90	-14.71	6.47
2.	BHATINDA	234333.	149666.	639.	1280 66.	88900.	694.	- 7.26	- 6.29	1.05
3.	FEROZPUR	163000.	114666.	703.	78600.	58433.	743.	- 8.70	- 8.07	.69
4.	GURDASPUR	18000.	14333.	796.	4000.	5000.	1250.	-17.13	-12.32	5.80
5.	HOSHIARPUR	38000.	27333.	719.	25000.	23666.	947.	- 5.09	- 1.77	3.49
6.	JULLUNDUR	29666.	26000.	876.	3333.	4333.	1300.	-23.90	-20.06	5.05
7.	KAPURTHALA	4333.	3333.	769.	0.	0.	0.	-99.99	-99.99	-99.99
8.	LUDHIANA	36000.	34333.	954.	4000.	4666.	1167.	-24.01	-22.07	2.55
9.	ROPAR	25000.	15333.	613.	19333.	18333.	948.	- 3.15	2.26	5.60
10.	PATIALA	71666.	51333.	716.	27666.	27000.	976 .	-11.21	-7.71	3.94
11.	SANGRUR	113333.	87333.	771.	43666.	38333.	878.	- 11.23	-9.77	1.64
	PUNJAB	774667.	563000.	727.	340667.	279667.	821.	-9.75	-8.36	1.53

GROUNDNUT

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

PAGE 164

SR. No.	STATE/DISTRICT	Average for 1962-63, 1963-64, 1964-65 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	Average for 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	O/O ANN. COMP. GROWTH RATE 1970-73 AND OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	0.	0.	0.	0.	0.	0.	0.00	0.00	0.00
2.	BHATINDA	110.	233.	2121.	1333	1533.	1150.	36.60	26.53	-7.36
3.	FEROZPUR	0.	100.	0.	1133.	833.	735.	0.00	30.35	0.00
4.	GURDASPUR	0.	0.	0.	0.	0.	0.	0.00	0.00	0.00
5.	HOSHIARPUR	13726.	12683.	707.	12366.	2200.	972.	- 5.51	-1.67	4.06
6.	JULLUNDUR	10843	10480.	966.	22133.	22600.	1021.	9.33	10.08	.69
7.	KAPURTHALA	8170.	7863.	962.	14166.	16600.	1172.	7.12	9.79	2.49
8.	LUDHIANA	44633.	50316.	1127.	60033.	54366.	906.	3.77	.97	-2.69
9.	ROPAR	5023.	4490.	894.	11633.	9066.	779.	11.07	9.18	-1.69
10.	PATIALA	19303.	18380.	952.	27333.	33233.	1216.	4.44	7.68	3.10
11.	SANGRUR	19523.	18866.	966.	28366.	27300.	962.	4.78	4.73	-.04
	PUNJAB	111333.	113363.	1018.	168590.	167833.	996.	5.32	5.03	-.26

R/MUST.

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

SRL. NO.	STATE/DISTRICT	AVERAGE FOR 1962-63, 1963-64, 1964-65 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	AVERAGE ØFOR 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	O/O ANN.COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	13766.	10886.	791.	30933.	20266.	655.	10.65	8.08	-2.31
2.	BHATINDA	30686.	16593.	541.	40733.	24710.	607.	3.60	5.10	1.45
3.	FEROZPUR	20916.	11493.	549.	32600.	21790.	668.	5.70	8.32	2.48
4.	GURDASPUR	2660.	1413.	531.	4333.	2533.	585.	6.29	7.57	1.20
5.	HOSHIARPUR	1456.	490.	336.	3733.	1566.	420.	12.48	15.64	2.80
6.	JULLUNDUR	1273.	540.	424.	1933.	800.	414.	5.36	5.04	-.30
7.	KAPURTHALA	0.	6.	0.	66.	33.	500.	0.00	22.28	0.00
8.	LUDHIANA	1393.	666	478.	2000.	1166.	583.	4.62	7.25	2.51
9.	ROPAR	1446.	610.	422.	2333.	766.	329.	6.16	2.90	-3.06
10.	PATIALA	9400.	4896.	521.	4000.	1900.	475.	-10.12	-11.15	-1.14
11.	SANGRUR	7000.	4033.	576.	7666.	3966.	517.	1.14	-.20	-1.33
	PUNJAB	90000.	51630.	574.	130333.	79500.	610.	4.74	5.54	..77

SESAMUM

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT & PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

SR. No.	STATE/DISTRICT	AVERAGE FOR 1962-63, 63-64-1964-65 (HECT) AREA	(TONNES) OUTPUT	(KG/HECT) YIELD	AVERAGE FOR 1970-71, 71-72, 1972-73 (HECT) AREA	(TONNES) OUTPUT	(KG/HECT) YIELD	O/O ANN. COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	6073.	2580.	425.	2673.	1317.	493.	-9.74	-8.05	1.88
2.	BHATINDA	23.	16.	714.	0.	0.	0.	-99.99	-99.99	-99.99
3.	FEROZPUR	600.	200.	333.	333.	131.	395.	-7.07	-5.08	2.14
4.	GURDASPUR	4796.	1836.	383.	7533.	2640.	350.	-5.80	4.64	-1.09
5.	HOSHIARPUR	886.	483.	545.	1300.	403.	310.	4.90	-2.23	-6.79
6.	JULLUNDUR	800.	246.	308.	366.	145.	395.	-9.28	-6.42	3.16
7.	KAPURTHALA	93.	26.	286.	33.	11.	350.	-12.07	-9.81	2.57
8.	LUDHIANA	33.	10.	300.	333.	155.	465.	33.35	40.86	5.63
9.	ROPAR	360.	173.	481.	1166.	405.	347.	15.83	11.19	-4.00
10.	PATIALA	296.	376.	1270.	233.	320.	1371.	-2.95	-2.01	.97
11.	SANGRUR	33.	3.	100.	101.	68.	669.	14.96	45.78	26.81
	PUNJAB	13997.	5953.	425.	14075.	5597.	398.	.07	-.76	-.83

LINSEED

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

SR.NO.	STATE/DISTRICT	AVERAGE FOR 1962-63, 1963-64, 1964-65 (AREA) (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	AVERAGE FOR 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	O/O ANN.COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	330.	190.	576.	100.	100.	1000.	-13.85	-7.70	7.14
2.	BHATINDA	0.	0.	0.	0.	0.	0.	0.00	0.00	0.00
3.	FEROZPUR	30.	20.	667.	0.	0.	0.	-99.99	-99.99	-99.99
4.	GURDASPUR	1183.	506.	423.	796.	466.	586.	-4.82	-1.01	4.00
5.	HOSHIARPUR	353.	186.	528.	466.	200.	429.	3.54	.87	-2.57
6.	JULLUNDUR	343.	170.	495.	300.	166.	556.	-1.66	-.24	-1.45
7.	KAPURTHALA	106.	33.	313.	0.	0.	0.	-99.99	-99.99	-99.99
8.	LUDHIANA	420.	236.	563.	66.	66.	1000.	-20.54	-14.64	-7.43
9.	ROPAR	256.	110.	429.	200.	100.	500.	-3.06	-1.17	1.95
10.	PATIALA	513.	246.	481.	300.	166.	556.	-6.48	-4.77	1.83
11.	SANGRUR	0.	66.	0.	66.	33.	500.	0.00	-8.29	0.00
	PUNJAB	3537.	1767.	500.	2297.	1300.	566.	-5.24	-3.75	1.57

SUGAR CANE

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

SR.NO.	STATE/DISTRICT	AVERAGE FOR 1962-63, 1963-64, 1964-65 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	AVERAGE FOR 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (TONNES)	YIELD (KG/HECT)	O/O ANN.COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	9666.	39000.	4034.	10148.	43666.	4303.	.61	1.42	.81
2.	BHATINDA	4000.	12666.	3167.	7525.	30166.	4009.	8.22	11.46	2.99
3.	FEROZPUR	7333.	26666.	3636.	8307.	31833.	3832.	1.57	2.24	.66
4.	GURDASPUR	14666.	50666.	3455.	20842	87000.	417∅4	4.49	6.99	2.39
5.	HOSHIARPUR	10666.	25333.	2375.	7566.	18000.	2379.	-4.19	-4.17	.02
6.	JULLUNDUR	17333.	66333.	3827.	14349.	61000.	4251.	-2.32	-1.03	1.32
7.	KAPURTHALA	4333.	13666.	3154.	3129.	11666.	3728.	-3.98	-1.95	2.11
8.	LUDHIANA	11666.	45000.	3857.	8167.	38000.	4652.	-4.35	-2.08	2.37
9.	ROPAR	10333.	29000.	2806.	9606.	38666.	4025.	-.90	3.66	4.61
10.	PATIALA	14333.	40000.	2791.	11126.	58000.	5213.	3.11	4.75	8.12
11.	SANGRUR	10333.	38000.	3677.	11133.	58666.	5269.	..94	5.58	4.60
	PUNJAB	114667.	386333.	3369.	111902.	476667.	4260.	-o.29	2.66	2.97

COTTON

LEVELS AND GROWTH OF AVERAGE AREA, OUTPUT AND PRODUCTIVITY FOR THE TRIENNIUMS 1962-65 & 1970-73

SR. No.	STATE/DISTRICT	AVERAGE FOR 1962-63, 1963-64, 1964-65 AREA (HECT)	OUTPUT (BALES)	YIELD (KG/HECT)	AVERAGE FOR 1970-71, 1971-72, 1972-73 AREA (HECT)	OUTPUT (BALES)	YIELD (KG/HECT)	% ANN. COMP. GROWTH RATE 1970-73 OVER 1962-65 AREA	OUTPUT	YIELD
1	2	3	4	5	6	7	8	9	10	11
1.	AMRITSAR	43583	47183	195	18333	31666	311	-10.25	-4.86	6.01
2.	BHATINDA	112826	191978	306	145233	314333	390	3.21	6.36	3.05
3.	FEROZPUR	172826	309889	323	177366	405666	412	.32	3.42	3.09
4.	GURDASPUR	5263	4794	164	3666	3666	180	-4.41	-3.30	1.17
5.	HOSHIARPUR	4210	2700	115	2333	1333	103	-7.10	-8.44	-1.43
6.	JULLUNDUR	13943	20833	270	7666	10333	243	-7.19	-8.39	-1.32
7.	KAPURTHALA	3106	4406	255	1000	1000	180	-13.20	-1692	-4.27
8.	LUDHIANA	33830	59611	317	23333	38000	293	- 4.53	-5.47	-0.98
9.	ROPAR	3426	2944	155	2333	2333	180	- 4.68	-2.87	1.91
10.	PATIALA	29000	45222	281	21000	33000	283	- 3.94	-3.86	0.09
11.	SANGRUR	68650	112889	296	56000	92666	298	- 2.50	- 2.44	0.07
	PUNJAB	490667	802461	294	458267	934000	367	- .84	1.92	2.79

AGRICULTURE IN TAMIL NADU: 1950-1965*

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Reviewing the performance of the agricultural sector of the State's economy early in the seventies the State Planning Commission's Task Force on Agriculture reported: "Agriculture in Tamil Nadu took big strides during the last two decades towards definite transformation from a stage of chronic stagnancy to that of self sustained growth, resulting in Green Revolution, which has been spreading in the State during the past five years"1. This paper attempts a critical examination of the nature of that transformation, as well as of the character of growth of agriculture in the State. In terms of its assessment of the experience of the past quarter of a century, the paper also raises some questions about the future of agriculture in the State.

I. PAST PERFORMANCE

A. Summary

1.1 Basic data pertaining to the past performance of agriculture in the State are available from the two official periodical publications, Season and Crop Reports and Tamil Nadu - An Economic Appraisal. Table 1 gives a picture of the cropping pattern in the State for different periods from the

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beginning of the First Five Year Plan. The periods chosen correspond to the successive Five Year Plans, beginning and end of the First Five Year Plan, end of the Second and Third Plans, end of the three Annual Plans and the end of the Fourth Five Year Plan. The nine crops or crop groups given in the table account for between 80 and 85 per cent of the gross cropped area. What the table shows is that over the quarter of a century there is no substantial change in the cropping pattern. Paddy[2] has been and is the most important crop in the State and has improved its position, most of it during the First Five Year Plan itself. The gain in paddy is offset by decline in other cereals which kept the share of cereals as a whole fairly steady except in the very last year when cereals go down mainly as a result of the fall in the share of the millets. The general stability of cereals is also shared by pulses as a group. The performance of groundnut and cotton has been erratic although of late, the former has registered marginal increase and the latter some decline. Among the crops sugarcane is the one that shows steady and striking increase over the period with its share in gross cropped area going up three times though the total is still not very large. Table 1 thus shows that during the past 25 years the two 'wet crops' paddy and sugarcane, have improved their positions while the dry crops, especially the non-paddy cereals have lost ground. It is seen also that the extension of paddy cultivation came about during the first decade whereas sugarcane registered its increase primarily in the second half of the period under review.

1.2 Table 2 examines changes in the area under 7 of the major crops which spell out more clearly the patterns observed in Table 1. Gross cropped area under paddy has gone by up slightly over 50 per cent. Most of the increase happened during the first decade, a substantial part during the First Plan period itself. The decline in the share of millets noticed in Table 1 is seen to be the result of absolute decline in the area under cultivation. Upto the end of the Third Plan there was marginal increase in the area under cholam which decline sincethen going below the 1951-52 level by 1968-69 and registering a further fall since then. Ragi has a fairly similar pattern except that the decline started from the end of the Second Five Year Plan. The area under cumbu has been coming down fairly steadily after a marginal increase in the first phase. Cumbu has registered the biggest fall in the area under cultivation, by more than 25 per cent. Area under groundnut moved up slowly at first, but picked up suddenly in the seventies. In the case of sugarcane there has been very striking increase but for the small dip during the First Plan period and a fall towards the end of the period. The area under cotton doubled during the first two Five Year Plans,

but has been coming down fairly steadily after a marginal increase in the first phase. Cumbu has registered the biggest fall in the area under cultivation, by more than 25 per cent. Area under groundnut moved up slowly at first, but picked up suddenly in the seventies. In the case of sugarcane there has been very striking increase but for the small dip during the First Plan period and a fall towards the end of the period. The area under cotton doubled during the first two Five Year Plans, but has been coming down since then except in the seventies when there has been a marginal upward movement. The following general pattern can be seen from Table 2. During the fifties there is an increase in area under cultivation of all major crops with the sole exception of cumbu. Hence the fifties may be treated as a period of extensive cultivation. In the sixties there is no major increase in the area under cultivation of any of the crops listed in the table except sugar cane with the area under all millets and cotton coming down. In the first part of the seventies area under paddy, groundnut, sugarcane and cotton go up with the three non-paddy cereals showing appreciable fall in area.

1.3 The pattern noticed in Table 2 must be supplemented by details about production and productivity to get a more complete picture of the agricultural change in the past quarter of a century. The trends in production are shown in Table 3. Over the entire period production has gone up in the case of all crops except ragi. The biggest change has been in sugarcane which shows a more than four fold increase, followed by paddy which moved up by more than two and a half times. Considering the fact that paddy is the main crop in the State this increase indeed has been very impressive showing an average annual rate of growth of 7.4 per cent. In terms of time profile there are some pertinent observations. The increase in paddy production is in the fifties, and the seventies with production remaining stagnant during the sixties. Production of cholam, cumbu, groundnut and cotton also increased in the fifties, then declined in the sixties and revived in the seventies. Ragi too had an increase in output in the fifties, but since then it has been declining. Sugarcane is the only crop which maintained a steady increase in output in the fifties and sixties, but it showed a decline in the early seventies.

1.4 Table 4 shows changes in productivity per unit of land. Surprisingly the biggest increase is in the case of cumbu whose yield has more than doubled. It is followed by paddy which shows a 70 per cent increase and cholam which has a 54 per cent increase. Sugarcane, cotton and ragi shows moderate increase. The poorest performance in terms of productivity is

that of groundnut which is almost a case of stagnation. The time profile, again, is interesting. In the fifties all crops show an increase in productivity although none of them is particularly impressive with the possible exception of sugarcane. In the sixties the productivity of cholam, ragi, groundnut and cotton decline; paddy, cumbu and sugarcane show marginal increase. In the early seventies there is an all-round improvement in productivity and all of them are big increases too.

1.5 The agricultural changes between 1951-52 and 1973-74 can now be summarised. In the fifties, there is an increase in the area under cultivation accompanied by some improvement in productivity. The sixties show stagnation in agriculture in area, production and productivity. The early seventies reverse the pattern and would appear to have started an upward trend especially in productivity and consequently in output. During the entire period a shift of land from dry to wet crops is also discernible.

B. Area Under Cultivation and Irrigation

1.6 The changes summarised above can now be taken up for detailed analysis. It is evident from the summary that increase in irrigation and the corresponding expansion of area under cultivation have been two of the main factors responsible for the changes at least till the end of the sixties. The total geographical area of Tamil Nadu is 130 lakh hectares. In 1951-52, 40.5 per cent of this total (about 54 lakh hectares) was net sown area. It moved up to 46.0 per cent (close to 60 lakh hectares) in 1960-61 and to 48.3 per cent in 1970-71 (almost 63 lakh hectares). Early in the seventies the State Planning Commission's Task Force on Agriculture expressed the view that "the scope for bringing additional area under the plough is limited". Net sown are according to the latest figure available (for 1973-74) was slightly less than 62 lakh hectares. Area sown more than once increased from 9.3 lakh hectares in 1951-52 to 13.2 lakhs in 1960-61, 12.5 lakhs in 1970-71 and 14.7 lakhs in 1973-74 leading to gross cropped area of 63.5 lakh hectares, 73.2 lakhs, 75.3 lakhs and 76.5 lakhs respectively. In terms of indices (with 1951-52=100) net

sown area increased to 110.5 in 1960-61 and to 113.8 in 1973-74 while gross cropped area moved up to 115.2 in 1960-61 and 120.3 in 1973-74, showing once again that the fifties constituted a period of extension in cultivation.

1.7. The extensive cultivation of the fifties was facilitated by the increase in irrigation. Total area irrigated was close to 20 lakh hectares in 1951-52 and rose to 24.6 lakhs in 1960-61. In 1970-71 it was still 24.8 lakhs. Since then there has been a significant increase to 28.1 lakh hectares in 1973-74. We shall have to examine subsequently the character of the increase in irrigation during these periods, but all the moment we shall concentrate on its quantitative dimension and its impact on the agricultural situation. Percentage of total gross irrigated area to the total area sown was 38.9 in 1951-52. It went up to 44.2 in 1960-61 and after moving up to a record high of 47.6 in 1967-68 slided down to 46.2 in 1970-71. Since then it went up again to 48.0 in 1973-74.

1.8. It has been noted already that the extensive cultivation of the fifties was shared by all main crops except cumbu, although the major changes were in the case of the two wet crops, Paddy and sugarcane as also of cotton (Table 2). The more important fact is that during the period of extensive cultivation the output per hectare of all crops, registered an increase. (Table 4). Extensive cultivation of the fifties, therefore, was not the usual case of less fertile land being brought under the plough resulting in an increase in total output, but with decrease in productivity. It was essentially a case of more dry land being converted into wet land through irrigation, although there was also some increase in net sown area also. It shows the fundamental importance of water in the agricultural situation in the State.

1.9. Another general feature of the change in agriculture brought about by the availability of water is the moment of land into food crops in general. Area under food crops (i.e. all cereals and pulses, condiment and spices, sugar crops, fruits and vegetables) was 69.5 per cent of gross cropped area in 1951-52. By the end of the First Plan Period it increased to 76.3 and with occasional minor fluctuations that proportion was maintained till the beginning of the

seventies. In 1970-71 food crops claimed 76.2 per cent of gross cropped area. Since then there has been a slight fall, the figure for 1973-74 being 74.0 per cent. The general increase in the share of food crops in the fifties was brought about by paddy extension. In the sixties there was some fall in the area under condiment and spices with a balancing increase in the case of fruits and vegetables, particularly banana (as also tapioca which is also listed under this general category). Between 1970-71 and 1973-74 although area under paddy increased marginally and of pulses substantially, the fall in the area under non-paddy cereals on the one hand, and the increase under oil seeds, especially groundnut and other non-food crops on the other led to the slight decline in the share of food crops.

1.10. Surveying the agricultural scene in the State over the past quarter of a century, it can thus be concluded that the major changes that call for explanation are the increase in the area under paddy in the fifties, the decrease in the area under non-paddy cereals (to be referred to as millets) in the sixties and the increase in the productivity of both paddy and millets in the seventies. In other words, for the state as a whole there was no major shift in cropping pattern as between food and non-food crops, and little that is noteworthy with regards to non-food crops during the past quarter of a century. Even within the food crops the main changes have been within the cereals group. This is one of the most important aspects of agricultural change in the State during the past.

C. Paddy and Millets :-

1.11. In order to study the relative performance of paddy and millets in the State during the period under review a detailed picture of changes in area, output and productivity of these two are presented in Table 5 (Paddy) and Table 6 (Millets). A comparison of the two tables shows the contrasting patterns of change of the two crops. From Table 5 it is seen that are under paddy increased generally, the exceptions being 1952-53, 1957-58, 1963-64, 1965-66, 1967-68, (1968-69, 1969-70 and 1973-74.

Output also increased, more steadily, the exceptions being fewer, 1952-53, 1958-59, 1963-64, 1965-66 and 1968-69. Productivity also has been going up systematically, the exceptional years being 1952-53, 1958-59, 1960-61, 1962-63, 1963-64 and 1968-69. In the case of millets (taking cholam, cumbu and ragi into account) the pattern is of the opposite kind. Area under cultivation increased only in 7 years from 1951-52 to 1973-74 and three of them were insignificant. Output increased during 11 years and productivity also during 11 years. Over the entire period area under paddy increased at the rate of 2.33 per cent per annum and of millets declined by 0.81 per cent per annum. Output of paddy increased at 7.40 per cent per annum whereas millets show an increase of only 0.51 per cent per annum. But in the case of productivity the two are much closer, that of paddy showing an increase of 3.23 per cent per annum and that of millets 2.56 per cent per annum. The latter, no doubt, is essentially a reflection of the remarkable increase in millets productivity in 1972-73 to 1973-74.

1.12 The time profiles of the changes are also worth special examination. Thus during the First and Second Plans (i.e. the fifties) the increase in paddy production came about mainly through an increase in area under cultivation. The Third Plan and the Annual Plans (roughly the sixties) were a period of stagnation as far as paddy cultivation was concerned. Since then paddy production has increased mainly because of the striking increase in productivity. In the case of millets the fifties were a period of stagnation, and the sixties one of deterioration. The decline in area and production continued into the seventies also, but accompanied by a perceptiable increase in productivity.

1.13 The evidence we have is suggestive of substitution of paddy for millets, particularly in the sixties. This aspect will be examined more fully in the next section where we look at cropping pattern at the taluk level. But the general evidence is presented here relating the process of substitution to irrigation. Table 7 brings together the relevant information.

1.14 Over the entire period increase in gross cropped area by 20.3 per cent accompanied by increase in gross irrigated area by 48.6 per cent led to an increase in area under paddy by 51.1 per cent and a decrease in area under millets by 17.8 per cent. During the period of extensive cultivation of the fifties area under millets also increased, but since then increase in gross irrigated area seems to lead to increase in area under paddy at the expense of decrease in millets, parti-

cularly during the sixties when the increase in gross cropped area is negligible. In the last phase, the decline in area under millets is even more pronounced. During that period millets lost ground even to groundnut and cotton.

1.15 The second general observation that can be made from an examination of Tables 5 and 6 is that there is an appreciable increase in the productivity of paddy from about 1967-68 (the fall in 1968-69 being the result of the big drought which caused a major fall in area cultivated also) and in the productivity of millets from 1969-70 onwards, although there was a major dip subsequently in 1971-72. These are indicative of the impact of the High Yielding Varieties Programme and so a quick survey of the changes that came about following it is necessary.

D. The High Yielding Varieties Programme

1.16 The fifties gave a fairly rosy picture of agricultural change in the State. Area under cultivation had gone up; there was also all-round increase in production and productivity. The food position was quite comfortable. Starting from 35 lakh tonnes in 1951-52 food grain production had moved upto 53 lakh tonnes in 1960-61 and on that basis a 70 lakh tonne target was set for the Third Five Year Plan. But aftermoving upto 57 lakh tonnes in 1962-63 food grain production tended to stagnate. It touched a low figure of 49 lakhs in the drought year of 1965-66 and just managed to return to the 1960-61 level next year.

1.17 The High Yielding Varieties Programme was launched in 1966-67 against this background. Already, the Intensive Agricultural Area Programme was started in Tanjavur in 1960-61 and extended to Madurai, Chingleput, Coimbatore and Tirunelveli, districts in 1965-66 as Intensive Agricultural District Programme. The IADP (Package Programme) as is well known, aimed at a package deal to increase the production of cereals involving the application of fertilisers, the use of improved seeds, plant protection methods, cultural practices etc., along with provision of timely credit, education through demonstration and the like.

1.18 The HYV Programme was inaugurated with cultivation of new varieties of seeds, particularly ADT-27 in paddy in 2.1 lakh hectares of land. The progress registered since then is shown in Table 8.

1.19 According to official statistics, thus, the HYV programme has had a rapid spread with more than three fourths

of the paddy area and over a quarter of the millet area already covered by the new programme. That the increase in coverage is also accompanied by an increase in the consumption of fertilisers can be seen from Table 9.

1.20 With such rapid increase in the utilisation of fertilisers, Tamil Nadu has become one of the most 'fertiliser conscious' States in the country. As against an all India average consumption of 9.34 Kg of nitrogen, 2.90 Kg. of phosphoric acid and 1.43 Kg. of potash per hectare in 1970-71 the State's consumption figures were 23.36 Kg., 7.81 Kg. and 5.79 Kg. respectively. Tamil Nadu came second only to the Punjab in the total consumption of fertilisers per hectare and stood first in phosphate application, second in potash and third in nitrogen. Since 1970-71 the demand for fertilisers in the State has been always in excess of the supply.

1.21 Under the impact of the 'Green Revolution' production and productivity of cereals in general and paddy in particular have gone up in the seventies as already noted in the tables given earlier. We shall postpone to Section IV a critical examination of the nature and future prospects of the 'Green Revolution'.

II. REGIONAL PATTERNS

2.1 In this section we shall attempt a regionally disaggregated analysis of the agricultural changes in Tamil Nadu. The analysis is confined to the sixties as it has not been possible to get the required data for earlier and more recent periods.

A. Cropping Pattern

2.2 First, we shall examine changes in cropping pattern dividing the crops into paddy, millets and all other crops, identified as P, M and R respectively. In terms of this grouping, changes in the cropping pattern in the districts is shown in Table 10. The table shows that the districts differ considerably in their cropping patterns and show distinct patterns of change also. The share of paddy ranges from below 10 per cent (in the Nilgiris) to above 70 per cent (in Thanjavur and Chingleput). There were hardly any millets in Kanyakumari whereas in Salem-Dharmapuri millets accounted for over 50 per cent in 1961 and above 40 per cent in 1971. "Other crops" also show considerable inter-district variation, with very low proportions in Chingleput and Thanjavur to very high proportions in the Nilgiris.

2.3 The analysis of the changes in the cropping pattern is best done at the taluk level partly because more patterns of change can be seen at that level, but also because information obtained at that level is more helpful for explaining the changes. The analysis is conducted in two stages: (1) an examination of changes in cropping pattern per se i.e., variation in the proportion of land used under the major crops over the decade; (2) an examination of actual changes in the cultivation of the major crops.

2.4 Changes in cropping pattern per se are indicated by percentage variations in respect of the three main crop groups, P, M and R[3]. Changes that lie outside one standard deviation of the mean are taken as significant and the others as not significant. On this basis the change in the cropping pattern over the decade is seen to be significant in 20 taluks, or approximately one fifth of the taluks in the State. The majority of these taluks are in the southern part of the State within the interior districts.

2.5 To proceed further with the analysis the taluks have been grouped on the basis of their "primary crop" for the initial period. Taking the percentage of area under the three crop groups for the State as a whole as the reference point, the "primary crop" of a taluk is taken as that crop (or crops) which accounted for a proportion higher than the corresponding State figure. On this basis 44 out of the 98 taluks are paddy taluks (P taluks) 19 millet taluks (M taluks) and one "Other crops" taluk (R taluks) and the rest two-principal crop taluks (TP taluks). The distribution of the 20 taluks showing principal crops is shown in Table 11.

2.6 The table shows that among the paddy taluks very few have shown significant variation in cropping pattern. Changes in cropping pattern have been highest in the millet taluks followed by two-principal crop taluks.

2.7 The above analysis of changes in cropping pattern in terms of variations in the proportion of crops cannot give information on the changes in the performance of particular crops mainly because changes in cropping pattern are accompanied by changes in the gross cropped area also. Hence it is necessary to find out the actual changes in the cultivation of the major crops (and crop groups) to see whether explanations can be found for such movements. Table 12 summarises the information on the actual changes in the three major crop groups over the decade at the taluk level.

2.8 The picture emerging from Table 12 appears to be very different from what was seen from Table 11. In terms of actual variations, 58 taluks had increase in the area under paddy, 24 taluks in area under millets and 51 taluks in area under other crops. At the same time there was decrease in the area under paddy in 40 taluks, in area under millets in 70 taluks and in area under other crops in 47 taluks. Of the 58 taluks where the area under paddy has gone up 40 are associated with increase in gross cropped area, and of the 40 taluks where the area under paddy came down 37 are associated with decrease in gross cropped area. In the case of millets in half the number of cases increase in area under cultivation is accompanied by increase in gross cropped area and the other half by decrease in gross cropped area. But in the case of decrease in the area under cultivation of millets, 30 are accompanied by increase in cropped area and 40 by decrease in cropped area. "Other crops" show a pattern fairly similar to paddy. From these it may be inferred that changes in the area under paddy and cash crops have been generally influenced by changes in total area under cultivation.

2.9 The relationship between changes in area under cultivation and changes in irrigation can also be interpreted similarly. In the case of paddy the association between changes in irrigation and changes in area under cultivation is quite pronounced. In the case of millets there is an inverse relationship between the two. "Other crops" again, follow the pattern of paddy, although not as definitely as in paddy. An examination of changes in irrigation and changes in gross cropped area shows that the two are very closely and positively associated. We may, therefore, conclude that increase in irrigation during the sixties encouraged the increase in the area under paddy and cash crops, but that the shift out of millets cannot be explained solely in these terms. However the conclusion we have arrived at by analysing changes in cropping pattern at the taluk level reinforces the findings of Section I regarding the importance of irrigation in causing a movement of land out of inferior cereals into paddy.

B. Production and Productivity

2.10 The analysis of production and productivity can be done only at the district level as data on these are not available for taluks. The analysis of production and productivity must decompose the increase in agricultural output into its components so as to identify, to the extent possible, the factors responsible for the increase. In this process we must

also explain the movements in the cropping pattern and relate them to some explanatory factors. There are, therefore, dissimilar entities that must be taken into account, area under cultivation, yield, prices etc. The method used must be capable of handling these diverse entities. The procedure used here is a modification of the Minhas-Vaidyanathan method.4

The method is as follows:

Crop	Price Weight in year		Proportions of Area in year		Per hectare yield in year	
	0	t	0	t	0	t
C_1	W_{1o}	W_{1t}	C_{1o}	C_{1t}	Y_{1o}	Y_{1t}
C_2	W_{2o}	W_{2t}	C_{2o}	C_{2t}	Y_{2o}	Y_{2t}
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C_n	W_{no}	W_{nt}	C_{no}	C_{nt}	Y_{no}	Y_{nt}

2.11 C_is and Y_is are crops and their yields, and W_is are the prices per unit of output of the crop. Denoting value of output by V and the gross cropped area by A with subscripts o and t standing for the initial and terminal periods, we have by definition

$$V_o = A_o \sum_i W_{io} C_{io} Y_{io} \text{ and}$$

$$V_t = A_t \sum_i W_{it} C_{it} Y_{it}$$

Terminal period output valued at base year prices can be said to represent the "real output" of the terminal year to be denoted by P_t. That is,

$$P_t = A_t \sum_i W_{io} C_{it} Y_{it}$$

with the help of this concept of real output, the difference in the value of aggregated output ($V_t - V_o$) can be decomposed into its "real" and "monetary" component. That is

$$V_t - V_o = (V_t - P_t) + (P_t - V_o)$$

The first term on the right

$V_t - P_t = A_t \left(\sum_i W_{it} C_{it} Y_{it} - \sum_i W_{io} C_{it} Y_{it} \right)$ is the difference between the terminal year aggregate output valued in terms of terminal year prices (W_{it}) and base year prices (W_{io}), and hence can be thought of as a measure of the monetary component in increase in output. The second term

$P_t - V_o = A_t \sum_i W_{io} C_{it} Y_{it} - A_o \sum_i W_{io} C_{io} Y_{io}$ is the difference between "real output" in the terminal year and "real output" in the base year, and hence can be said to be the measure of the real component in increase in output.

$P_t - V_o$ can further be decomposed as follows:[5]

$$P_t - V_o = (A_t - A_o) \sum_i W_{io} C_{io} Y_{it}$$
$$+ A_t \sum_i W_{io} C_{io} (Y_{it} - Y_{io})$$
$$+ A_t \sum_i W_{io} Y_{io} (C_{it} - C_{io})$$
$$+ A_t \sum_i W_{io} (Y_{it} - Y_{io}) (C_i - C_{io})$$

The first term on the right is the area effect and the second term the yield effect. The third term portrays the effect of changes in crop patterns in the absence of any changes in yields per acre and may be referred to as the cropping pattern effect. The last term measures the effect on output which can be attributed to interaction between per hectare yield changes and the changes in cropping pattern. This may simply be denoted as the interaction effect. The decomposition, therefore helps to identify the various factors responsible for the increase in output.

2.12 A decomposition of the monetary component also is possible.

$$V_t - P_t = A_t \sum_i C_{io} Y_{io} (W_{it} - W_{io})$$

$$+ A_t \sum_i C_{io} (W_{it} - W_{io}) (Y_{it} - Y_{io})$$

$$+ A_t \sum_i Y_{io} (W_{it} - W_{io}) (C_{it} - C_{io})$$

$$+ A_i \sum_i (W_{it} - W_{io}) (C_{it} - C_{io}) (Y_{it} - Y_{io})$$

The first component in the split-up is the pure price effect i.e., in the absence of any change in total output an increase of this magnitude in the value of output is solely due to increase in prices. The second term represents the interaction of price changes and yield changes under constant cropping pattern and may be called the price-yield effect. Similarly the third component may be referred to as the price-cropping pattern effect as it indicates the interaction between price changes and cropping pattern changes with constant yield. The last term representing the interaction of changes in prices, cropping pattern and yields may be called the total interaction of changes in prices, cropping pattern and yields may be called the total interaction effect.

2.13 With this overall frame for the decomposition of changes in agricultural performance we may take up an analysis of agricultural change in the different districts in Tamil Nadu.

2.14 To reduce the problems of year to year variations in the various components two year average have been used for the base period (1960-62) and the terminal year (1969-71). In choosing the crops for analysis the primary consideration was that maximum coverage should be ensured. The availability of data on prices, area and yields was the constraint. For the State 18 crops have been taken into account and the coverage is close to 90 per cent of cropped area in the base period and the terminal period. The number of crops included ranges from 5 in the case of Kanyakumari and 15 in South Arcot and North Arcot. The coverage also is low for Kanyakumari (59.85 per cent in the base year and 56.06 per cent in the terminal year) but is over 85 per cent in all other cases and over 90 per cent for South Arcot, North Arcot, and Tiruchirapalli. Coverage is low in the case of Kanyakumari because the district

has awide variety of crops that occupy insignificant proportion in terms of total cropped area and for which yield figures are not available. The Nilgiris have been left out because of its dominating estate economy that does not easily fit into the general pattern of analysis.

2.15 The results of the analysis are summarised in (Table 13) column 2 in the Table indicates overall growth rate, $\frac{V_t - V_o}{V_o}$. The increase in value of agricultural output for the State as a whole, thus, is 101.47 per cent over the period 1960-62 to 1969-71. Inter district comparison of overall growth shows considerable variation ranging from 135.93 per cent in South Arcot to 49.77 for Kanyakumari. The performance of Chingleput, South Arcot, Thanjavur and Ramanathapuram is better than that of the State with the performance of the other districts being below the State level. The overall growth is decomposed into real growth (column 7) and monetary growth (column 12) with 8.22 per cent of the overall growth of the State being real and 91.78 per cent being monetary. Column 7 also shows significant inter-district variation with the highest being Chingleput's 26.61 and the lowest Kanyakumari's 27.86. Again, the real growth performance of Chingleput, South Arcot, and Thanjavur is better than that of the State while Salem, Coimbatore, Tiruchirapalli, Madurai, Ramanathapuram, Tirunelvei and Kanyakumari have figures lower than that of the State. It is significant to note also that real growth of agricultural output has been negative in Salem, Coimbatore, Madurai, Tirunelveli and Kanyakumari. As might be expected the variation in monetary growth is not as pronounced as in real growth. Monetary growth is above the State figure in Salem, Coimbatore, Tiruchirapplli, Madurai, Tirunelveli and Kanyakumari, and below the State figure in Chingleput, South Arcot, North Arcot, and Thanjavur. Because real and monetary growths are the decomposition of the overall growth in per centage terms there is necessarily an inverse relationship between the two; but a comparison of columns 7 and 12 shows that monetary growth has been negative. (Tiruchirappalli is the only district where the monetary growth is distinctly above the State figure, but where real growth has been positive, just a marginal 0.39 per cent)

2.16 The two major components of overall growth, real growth and monetary growth, themselves have been further split up into the various "effects" in columns 3 to 6 and columns 8 to 11 respectively. The area effect is most prominent in Thanjavur. In fact Thanjavur and South Arcot are the only districts with any appreciable positive area effect. What column 3 shows is that the area effect is negative for the State as a whole and for 7 out of the 11 districts with Tirunelveli (-17.17) Kanyakumari (-13.60) Salem (-9.21) Madurai (-7.31) and Coimbatore (-7.24) showing prominent negative area effect.

2.17 There is considerable variation in the yield effect also. The yield effect for the State as a whole and for the majority of the districts is positive. Chingleput tops the list with 27.55 followed by Tirunelveli's 23.02. Negative yield effects are seen in Kanyakumari (-15.13) Salem (-3.06) and Tiruchirappalli (-0.68). Comparing columns 7 and 4 it is evident that the main component of real growth is the yield effect. For the State, yield effect accounts for 7.29 of 8.22 real growth. Chingleput, South Arcot and North Arcot which show high real growth have high yield effects and the negative real growth of Kanyakumari and Salem are also associated with negative yield effects. Tirunelveli and Coimbatore have high yield effects, but their negative area effects covert the total also into negative signs.

2.18 Turning now to columns 5 and 6 we note that the cropping pattern effect and the interaction effect are on the whole negligible. In Salem there is a substantial cropping pattern effect. We have seen already that the change in cropping pattern in Salem was from millets to paddy (Table 10), and in view of the major role that paddy plays in the agrarian economy of the State the high cropping pattern effect of Salem makes sense.

2.19 In fact the relative performance of the districts can be explained with reference to paddy as the main explanatory factor. Where area under paddy has been high and paddy productivity has gone up the real growth rate has been positive. Chingleput, South Arcot and North Arcot are the clear cases. Thanjavur, though with a positive real growth, does not rank high because over the decade paddy has come to have a smaller percentage of area and the increase in paddy productivity has not

been appreciable. On the other hand areSalem, Madurai and Tirunelveli where the real growth rate was negative. In Salem there was an increase in paddy area, but the increase in paddy productivity has not been impressive. Madurai and Tirunelveli shows increase in productivity but the paddy area has come down. Coimbatore which shows a marginal negative real growth had a big increase in the productivity and production of paddy although its paddy area is low. In the case of Kanyakumari which shows the biggest negative real growth over the decade there was a decline in paddy area, productivity and production, the decline in paddy production being a fall from 112,321 tonnes at the beginning of the period to 96,735 tonnes at the end, a 14 per cent fall.

2.20 It is possible to group the districts together as paddy (wet) districts and other (dry) districts. Thanjavur, Chingleput, Kanyakumari and South Arcot belong to the former group and the rest to the latter. The former have between 40 and 75 per cent of their gross cropped area under paddy, with correspondingly low proportions of land under millets, and other crops. The dry districts, by contrast are more diversified. But while the wet districts have more area under paddy the dry districts show generally higher productivity of paddy. In 1960-62, although the highest yield of paddy was in Kanyakumari with 1799 Kg. per hectare, Salem came next with 1798 Kg., Coimbatore third with 1792 Kg., and Tirunelveli fourth with 1776 Kg. On the other hand the district average for Thanjavur was 1603 Kg., of South Arcot 1553 Kg., and of Chingleput 1170Kg. At the end of the period (1969-71 average) average productivity of paddy went up almost throughout the State, but the dry-wet differences in productivity became more pronounced. The first three places were claimed by Coimbatore (2764 Kg), Tirunelveli (2376 Kg.) and Salem (1949 Kg) while South Arcot's figure was 1906 Kg., Chingleput 1692 Kg., Kanyakumari 1659 Kg., and Thanjavur 1628 Kg. It is interesting to note that Thanjavur, said to be the home of the 'Green Revolution' did not show much of an increase in the average productivity of paddy.

III. NATURE OF AGRICULTURAL CHANGE IN TAMIL NADU

3.1 Having surveyed the past performance of agriculture in the State both at the State and the district levels we can turn to an evaluation of the nature of changes that agriculture has undergone in Tamil Nadu during the first quarter of a century of planned economic development.

A. Structural Changes

3.2 The share of agriculture and allied activities in the net state domestic product has been declining as can be seen from Table 14. This can be explained both in terms of the stagnation of agriculture particularly in the sixties and the rapid growth of industries in the State during the decade. However, it cannot be taken as a definite indication of "industrialisation" in the State. Agriculture and allied activities (i.e., the primary sector) accounted for 63.33 per cent of the workforce in the State in 1961 which went upto 64.79 per cent in 1971. In fact, the chances are that agriculture probably had a larger proportion of the labour force in 1971 than indicated by these figures as the change in the definition of "workers" in the 1971 census would have affected the agricultural sector more adversely than the industrial sector.[6] In this sense it can be maintained also that what has happened in the State was something of a process of "deindustrialisation". In this process the relative productivity of the primary sector has sharply deteriorated. Taking the productivity of workers in the economy as a whole as 1, the relative productivity of the agricultural (primary) sector was 0.78 in 1961 while that of the secondary sector was 1.09. The corresponding figures for 1971 were 0.64 and 1.47 respectively.

3.3 But the more significant change in the composition of the workforce has been in terms of the division of agricultural workers into cultivators and agricultural labourers. In 1961, 51 per cent of agricultural workers were cultivators and 22 per cent agricultural labourers (with the rest being 'other workers'). In 1971 the proportion of cultivators declined to 40 per cent, and of agricultural labourers shot up to 38 per cent. These figures derived from the Census Reports of the two years cannot be compared directly again because of the changes that came about in the definition of 'workers' and in the procedure of classifying agricultural workers into 'cultivators' and non-cultivators. But a detailed examination has shown that the change in the proportions of cultivators and agricultural labourers is not something that can be explained away in terms of the differences in the Census definitions.[7] A big increase in the proportion of agricultural labourers must be accepted as one of the main structural changes in agriculture in the State during the past decade.

3.4 Making use of the data from the 8th, 16th, and 26th rounds of the National Sample Survey it is also possible to examine the nature of land ownership and holdings in the State

in 1954-55, 1961-62 and 1971-72. The ownership patterns are summarised in Table 15 and the operational holding patterns in Table 16.[8] The tables do not indicate any striking changes in the pattern of ownership or holdings over time.[9] The ownership patterns show slight decrease in inequality particularly between 1954-55 and 1971-72, but with respect to operational holdings there is hardly any noticeable change.

3.5 In view of the many radical land reform measures enacted in the State since Independence, particularly in the sixties one would have expected very drastic changes in the land ownership patterns in the State.[10] After a series of Acts protecting the rights of the tenants and regulating rent in the fifties, the Madras Land Reforms (Fixation of Ceiling on Land) Act of 1961 introduced ceiling limits on agricultural holdings. The Act fixed the ceiling on agricultural land that can be held by a family consisting of not more than five members at 30 standard acres. For those families having more than five members an additional five standard acres was allowed for each additional member subject to an overall limit of 60 standard acres. The 1961 Act was amended in 1970 reducing the ceiling limit to 15 standard acres for a family of five persons and the overall ceiling limit to 40 standard acres for any family above this size. The norm used for arriving at "standard acre" in both these Acts was one acre of wet land assessed at the rate of Rs.10/- and above per acre with increase in acreage permitted as one moved down to dry land and land with lower assessment, reaching a maximum of four acres.

3.6 There were also other pieces of legislation affectin the ownership and use of land during the sixties. The Tamil Nadu Agricultural Lands Record of Tenancy Rights Act of 1969 proposed to prepare a record of tenants in districts so that the intermediaries or landholders would not take advantage of the measures brought into protect the rights of tenants. Similarly, the Madras Occupants of Kudiyiruppa (Protection from Eviction) Act, 1964 aimed to protect tenants and agricultural labourers from being evicted from their kudiyiruppu (i.e. place of residence). The Madras Occupants of Kudiyiruppu (Conferment of Ownership Rights) Act 1971 followed it up by laying down the procedure to confer ownership rights (pattas) to the Kudiyiruppudar concerned.

3.7 Perhaps these laws resulted in the slight improvements in the ownership patterns noticed at the bottom end of the distribution in Table 15 particularly. However, it is now a

well known fact that the land reform legislations, particularly the land ceiling laws have not been seriously implemented. A recent study evaluating land reform measures, in the State came to the following conclusions: "The agrarian reform movement in the State is characterised by sound and comprehensive body of legislation on the one hand and on the other a very slow rate of execution, by partial and pilot coverage of the State by cotinuing loopholes which allow evasion and benami transactions. The result is that neither the equity nor the increasing production objective has been well served".[11] This conclusion is based on an official assessment of land reform measures in the State. The Board of Revenue's Land Reforms Progress Report, 1972 and the debates in the State Assembly on it brought out the following facts about the enforcement of land ceiling legislations.[12]

1.	Surplus to ceiling as estimated by the Government	2,182,105 standard acres
2.	Actually taken possession by the State	28.104 acres
3.	Extent under dispute in courts	6,972 acres
4.	Actually distributed by the Government to landless	20,977 acres.

It is seen that only less than 1 per cent of the estimated surplus has been actually distributed. Thus, land reforms, on the whole, have not brought about any major transformation in the ownership patterns of land in the agricultural sector.

3.8 The progress made in mechanisation particularly use of modern implements also has not been very striking except in very recent times. Table 17 gives information on the changing pattern of agricultural implements in use in the State. Wooden ploughs are the main agricultural implement in use and its use has continued to increase. There is an increasing reliance on iron ploughs and the number of tractors has shown a big increase after the second half of the sixties. The quinquennial Livestock Census, 1974 also reports the use of disc ploughs, disc harrows, tillers, levellers and trailers in different parts of the State. Dusters and sprayers are also coming into use.

3.9 But when it comes to pumpsets for irrigation Tamil Nadu has a success story to narrate. Now the State ranks first in the country in terms of the number of pumpsets claiming over 40 per cent of the pumps connected with electricity in the whole country. Both oil operated and electrically operated pumpsets have registered big increases as can be seen from Table 18. There has been, therefore, something of a "pumpset revolution" in Tamil Nadu and it is closely related to the new strategy for agricultural development pursued by the State which we shall now take up for discussion.

B. The Strategy

3.10 In the fifties the policy of the State in regard to agricultural development was to provide the basic overheads, particularly irrigation water. Providing irrigation water for agriculture was one of the main economic activities of the State even during the pre-Independence days. Of the total geographical area of 13 million hectares and a sown area of 6 million hectares the average net area irrigated in a year was a little over 2 million hectares during the First Plan period and 2.3 million hectares during the pre-independence days. Of the total geographical area of 13 million hectares nd a sown area of 6 million hectares the average net area irrigated in a year was little over 2 million hectares during the First Plan period and 2.3 million hectares during the Second Plan period with the figure for 1960-61 being 2.5 million hectares. With the Parambikulam-Aliyar Project started during the Second Plan and spilling over into the Third Plan the State seems to have reached its limits in terms of major irrigation projects. The extensive cultivation of the fifties was made possible because of these major irrigation schemes. It is now held that further extension to irrigation on a large scale from major and even medium projects would require import of water from catchments draining into other states.[13] Hence from the Third Plan onwards there has been a shift into minor irrigation Projects. As can be seen from Table 19 the shift has been quite marked indeed.

3.11 The shift from major to minor irrigation reflected not only changes in irrigation policy. As the primary sources of minor irrigation are tanks, wells, tube wells, bouring-in wells etc., the shift also brought about a change from irrigation as a public utility to irrigation as a private activity to be subsidised by the State. It fitted in with the rest of the agricultural policy of the late sixties of subsidising farmers to increase production as part of a crash programme to

augment agricultural output, especially food grains production. It is important to examine the impact of this strategy on the agricultural sector in general and on different sections of cultivators in particular. The World Agricultural Census, Tamil Nadu, 1971 gives information about the cropping pattern and sources of irrigation of different sizes of operational holdings in the State and are shown in Tables 20 and 21.

3.12 It is seen from the Tables that gross cropped area as a percentage of operated area decreases steadily as the size of holding increases. In the lowest classes it is higher than or close to 100 per cent, but comes down to less than 50 per cent at the top. Small holders, it must be inferred, make the utmost use of their land while the bigger holders do not put their land to full use. Irrigated area as a percentage of sown area also shows a similar pattern, high in the case of small holdings and low in the case of big holdings. It is seen further that the small holders use their land to produce foodgrains, with only a very small proportion of land used for non-food grains. The Agricultural Census does not give information regarding the use of family and hired labour in the different size classes, but other sources show, as may be expected, that the smaller size classes rely largely on family labour although they too employ hired workers.[14] We may, therefore, conclude that the small size classes are essentially peasant farmers making full use of the land and labour they have to produce food grains with the help of whatever irrigation facilities are available to them. On the other hand, the larger size classes are commercial producers using sizable share of their cultivated land for the production of cash crops. They also do not use their land to the fullest extent, but have the possibility to increase the utilisation of land if irrigation facilities increase.

3.13 Table 20 which shows the sources of irrigation for the different size classes indicates that the smaller size classes depend primarily on canals and tanks whereas in the higher size classes anywhere between 30 and 40 per cent of land is irrigated by wells, i.e. private sources of irrigation.

3.14 It is against this background that we must examine the shift in the irrigation policy of the State and its impact on farmers of different size classes. The area irrigated by Government canals increased steadily from 722,000 hectares in

1952-53 to 791,000 at the end of the First Plan and to 888,000 at the end of the Second Plan. In 1962-63 it moved up further to 923,000 hectares, but then began to decline reaching a low level of 798,000 in 1965-66. It picked up slowly after than but in 1970-71 it was only 861,000 only slightly higher than the Second Plan period average of 838,000. There has been a revival since then, the area going up to 941,000 hectares in 1972-73, and coming down somewhat to 924,000 in 1973-74. Net area irrigated by tanks moved up from 637,000 hectares in 1952-53 to 946,000 in 1962-63, but began to go down thereafter. It reached a high of 990,000 hectares again in 1967-68 but moved down again picking up again only in the seventies to reach a figure of 949,000 in 1972-73 (after some fluctuations) and moved upto 905,000 hectares in 1973-74 almost equalling the area irrigated by canals and tanks. Most impressive has been the case of land irrigated by tube wells. It appeared for the first time in 1954-55 (1,100 hectares), reached a high of 7,000 in 1963-64 but declined rather sharply the next few years. There were 19,000 hectares irrigated by tube wells in 1970-71 which rose steeply to 26,000 in 1973-74. This is an aspect of the "pump set revolution" descibed earlier which, we must conclude, conferred special benefits to the bigger farmers.

3.15 It was not only the irrigation policy of the State that had a bias in favour of the bigger farmers, however. It is generally known that financial assistance provided by the State to the agricultural sector has gone primarily to the larger farmers. In 1970 Directorate of Agriculture, Tamil Nadu conducted a survey to find out the nature of credit distribution in the agricultural sector.[15] It was seen that per farmer Government credit was Rs.85.5 in the case of farmers with less than 2.5 acres, Rs.248.4 for farmers in the next size class between 2.5 and 7.5 acres, Rs.857.1 in the case of those with between 7.5 and 15.00 acres, and Rs.416.7 for farmers above that size. On this basis the per acre government credit among the size classes in ascending order was seen to be Rs.54.5, Rs.52.9, Rs.81.2 and 18.6. This appeared quite 'fair', but the pattern was seen to change substantially with respect to cooperative credit. Per farmer credit from the cooperatives in ascending order of size classes was Rs.67.2, Rs.579.2, Rs.1160.3 and Rs.5172.2 and per acre in the same order Rs.44.7, Rs.123.4, Rs.110 and Rs.231.1.

3.16 It is clear that these policies had their impact on the HYV programme too. The technology of the HYV programme is now generally conceded to be size neutral, but the accessibility to it increases considerably with size. This aspect

has not been as adequately studied in Tamil Nadu as in some of the other states. But two recent studies have shown that the adoption rate of HYV programme has been considerably influenced by the size of operations and asset structure of farmers although it is not confined to large farmers alone.[16] We may, therefore, conclude that the agricultural strategy of the late sixties was to increase output, particularly of paddy relying mainly on the large farmers by making available to them at subsidised rates electricity and thereby water, credit, high yielding seeds and the complementary inputs required to boost production.

3.17 The shift from millets to paddy that came about during the sixties can be shown to be closely related to this strategy. When water becomes available to the larger farmers, they find it much more profitable to shift land from the cultivation of millets to commercial crops like cotton and groundnut or to paddy when the water supply is adequate.[17]

3.18 While the general strategy consisted of assistance to (large) farmers who would increase output and marketed surplus some attention was also paid to the special needs and problems of the small and marginal farmers. A Small farmers Development Agency was set up in 1970-71 in six Blocks in South Arcot, nine Blocks in Madurai and five blocks in Tirunelveli districts. The scheme was intended to identify the "potentially viable small farmers" and to assist them in relation to their specific requirements. In recent years the coverage has been extended to North Arcot and Salem also. It has been claimed also that by 1974 from 50 to 95 per cent of the small farmers in the different districts were "covered" by the scheme, but loans for farmer including long term, medium term and short term in the different districts ranged from Rs.400 to Rs.1200 per annum,[18] as against the officially estimated credit requirement of Rs.1700 per farmer in the size class of less than 2.5 acres and over Rs.3700 per farmer in the size class of between 2.5 and 9.5 acres.[19] Some provisions were made for marginal and sub-marginal farmers and agricultural labourers also through the "Marginal and Sub-marginal Farmers and Agricultural Labourers Development Agency" which in 1974 is claimed to have covered 77 per cent of the total in Salem district and 42 per cent in North Arcot giving a loan of Rs.480 per annum on the average in Salem and Rs.500 in North Arcot according to official Statistics.[20]

IV SOME QUESTIONS ABOUT THE FUTURE OF AGRICULTURE IN TAMIL NADU

4.1 The review and analysis of the performance of agriculture in the State have shown that the significant features of agricultural change in the past have been : (a) A shift of land from dry crops to wet crops because of the availability of water; (b) increase in the productivity of cereals, particularly millets resulting from the HYV programme and (c) The role played by the bigger farmers in the transformation of agriculture thanks to the irrigation and financial policies of the State. To see what impact these will have on the future growth and change of agriculture in the State it is necessary to raise some questions about each one of these components. We shall take them up under three heads, the Green Revolution, irrigation and farmers.

A. The 'Green Revolution'

4.2 The brief treatment of the HYV Programme in Section I has shown that it has 'caught on' in the State, particularly in the case of paddy. It was also noticed that productivity of paddy and more recently of the millets also have gone up significantly under the impact of the Green Revolution. Can one, therefore, look forward to a "Greener Revolution" in the future?[21] To answer this question we must make a critical assessment of the green revolution in the past. A second look at Table 5 will be helpful to evaluate the impact of the green revolution in paddy. It has been noted already that the HYV programme was introduced against the background of the deteriorating performance of paddy production and productivity in the early sixties. The impact of the HYV programme was first seen in 1966-67 when the production of paddy went up to 3,791,000 tonnes from the previous year's 3,524,000 tonnes. But 1965-66 was a drought year which resulted in a fall in the output of paddy from the peak figure of 4,036,000 tonnes it had registered in 1964-65. The next two years of good paddy performance were 1969-70 and 1970-71 when production shot up to 4,012,000 tonnes and 5,0007,000 tonnes respectively. It turns out, however, that these two years were also preceded by severe drought. The 1968-69 output of paddy was only 3,550,000 tonnes. Hence, even in 1969-70 paddy production had not equalled the 1964-65 level, or even the 4,024,000 tonnes reached in 1962-63. It is true that after recovery from the drought of 1968-69, the full potential of the HYV programme in paddy began to be realised. Paddy production in 1971-72 was, 5,302,000 tonnes in 1972-73 5,569,000 tonnes and in 1973-74 5,595,000 tonnes.

4.3 Figure 1 indicates the performance of paddy from 1951-52 to 1973-74. The figure also shows the calculated trend line[22]. It is evident that upto 1964-65 there was a steady increase in output with actual production being above the trend line during most of the years. From then production remained below the trend line upto1970-71. Often the impact of the HYV programme is evaluated against the background of the poor performance of the second half of the sixties. The 13.01 per cent increase in the production of paddy between 1968-69 and 1969-70 and the even more striking 24.80 per cent increase between 1968-69 and 1969-70 are the figures that gave the green revolution its 'revolutionary' appearance. But a scrutiny of Table 5 and Figure 1 shows that in longer perspective the achievements of the green revolution are much more modest, in fact disturbingly so. The trend line indicates a long term rate of growth of slightly over 6.0 per cent per annum. Table 5 shows that the actual rate of growth during many years prior to the introduction of the HYV programme was above this rate. Only in the sixties it came to be steadily less than the trend value. What is even more striking is that after the 'miracle years' of 1969-70 and 1970-71, the growth rate again goes <u>below</u> the trend. And in fact the growth rate appears to level off in the final year. The official tendency has been to put the blame again on the weather, but has been shown that it is a lame excuse.[23] On the contrary there is evidence to suggest that the green revolution is already showing weariness. According to official figures only 45.4 per cent of total paddy area was under the HYV programme in 1969-70 which is said to have moved up to 78.0 in 1973-74. If such vast tracts in fact came under the HYV programme, the returns have been poor indeed. Is the HYV programme showing diminishing returns already?[24]

4.4 There is a further question that Table 5 raises. It was shown that the area under paddy increased considerably in the fifties going up from 1,789,000 hectares in 1951-52 to 2,538,000 hectares in 1961-62. In the sixties there was no major increase in the area under paddy: it was around 2,6000,000 hectares, even the figure for 1970-71 being 2,636,000 hectares. But in 1971-72 it moved upto 2,690,000 hectares and in 1972-73 to an all time high of 2,851,000 hectares, with a small fall again in 1973-74. What these figures indicate is that the increase in paddy production achieved during the HYV period, particularly from 1969-70 to 1972-73 must be attributed to extension of area under cultivation

also, achieved primarily at the expense of millets (See Table 6). Consequently the green revolution contribution to the increase in the productivity of paddy has not been particularly striking as Table 5 shows. A cost-benefit analysis of the HYV programme in the State is yet to be done, but the evidence we have leads us to ask whether the green revolution in the State was primarily a HYV resolution or a pumpset revolution. The future performance of paddy in the State can be assessed only after this question is satisfactorily answered.

4.5 Apparently the HYV programme has had more conspicuous success in the case of millets where production and productivity have both gone up in recent years in spite of the fall in area under cultivation as can be seen from Table 6. It has been estimated that the yield per hectare of HYV cholam is about 1,500 Kg. per hectare compared to 550 Kg. of traditional varieties. Corresponding figures for cumbu are 2,000 Kg. and 600 Kg. respectively and for ragi 1,500 Kg. and 800 Kg. respectively. These are, of course, achievements under "ideal" conditions where in paddy also it can be shown that the yield per hectare of some of the HYV seeds is between 2 and 3 times that of traditional varieties. But our examination of paddy has shown that these ideal conditions are seldom achieved in reality and that the HYV has not so far shown a <u>sustained</u> increase in aggregate production and productivity. In the case of millets there is an additional question to be raised. If the HYV programme in millets also depends, to some extent at least, on the increased availability of water, will land be utilised for millet cultivation? If water is available paddy cultivation is definitely more profitable to the farmers and hence it is difficult to visualise a situation where HYV programme in millets becomes widespread. Further, since millets are "inferior goods" in the preferences of consumers there is a secular bias against any large scale increase in the consumption of millets. One of the areas that needs to be examined carefully in the study of the future of agriculture in the State is its "millet economy" - who are the producers of millets, what are the major factors that determine the substitution of paddy and millets in production, who are the consumers of millets, what is the elastdity of substitution between paddy and millets in consumption, what are the marketing arrangements for millets etc. At the moment our information on these questions is rather scanty.

B. Irrigation

4.6 In Sections I and II we noticed the importance of irrigation in Tamil Nadu's agricultural transformation of the past quarter of a century and in Section III we examined the new strategy in irrigation. If the possibilities of additional major and medium irrigation schemes do not exist any more then reliance on minor irrigation schemes is a matter of necessity and several new schemes have been taken up during the past decade.[27] But it is important to recognise the full implications of a policy of minor irrigation, particularly tube well and well irrigation in the State. The reliance on minor irrigation where land is privately owned and the distribution of land is heavily skewed is to accept a principle of subsidisation of rich farmers. It may be that the subsidies are or can be made available to all farmers, but it must be evident that only those farmers who can afford to find some resources of [illegible] their own can take advantage of such subsidies. The large farmers have in the immediate past used the new irrigation facilities to shift from the cultivation of millets to paddy, but there is nothing to say that the shift should be confined to the staple foods. Already sugarcane has registered an impressive increase in area under cultivation thanks to the availability of water. If such tendencies continue it is not impossible that Tamil Nadu's agriculture may become highly commercialised in the future and the State may turn out to be a deficit State in terms of rice like its neighbour Kerala. Even as it is a small fall in production of food grains, particularly of paddy, leads to big falls in marketed surplus. In a state where urbanisation is taking place at a rapid pace even marginal decline in the market availability of food grains can cause alarming scarcity situation and price increase as became evident in 1974-75 when during a period of less than 6 months there was almost a 300 per cent increase in the open market price of rice.

4.7 Neither is this the only kind of problem that the new irrigation policy can give rise to. Large farmers who come to have unrestricted availability of irrigation water built on public subsidies can easily acquire disproportionately high control over the entire agricultural situation. If land reform measures in the past could not be effectively implemented it was in no small measure due to the open and subtle opposition of the big farm lobby which already exists in the State. Hence for the future of agriculture in the State it is important to settle whether the policy of the State is to make strong farmers grow stronger.

C. Farmers

4.8 That question is not limited to the irrigation policy alone. In fact in a long term strategy for agriculture careful attention will have to be given to the total strategy to be adopted. All States in the country have the problem of the coexistence of big and small farmers. But Tamil Nadu has certain special problems in this regard. Recent studies have shown that a very large proportion of cultivators in the State come below the poverty line.28 And although it has not yet been established beyond doubt it would appear also that the increase in the number and proportion of agriculture labourers in the State is partly at any rate the result of small cultivators having to abandon farming. It has been noted also that the proportion of the workforce depending on agriculture has been going up and the relative productivity of the agricultural sector has been declining. It is possible too that the surging "urbanisation" of Tamil Nadu is an indication of rural distress.29 So, in the final analysis questions such as the future of cropping pattern in the State, the place of agriculture in the total economy of the State and all other related questions will depend on which groups of farmers are getting the effective patronage of State policy now. Even more important is the question of the land policy that will be adopted in the coming years. Although it is often conveniently forgotton, it is not altogether an accident that the fundamental issues in agricultural policy turn out to be those related to the ownership of and control over land.

NOTES

1. State Planning Commission, Towards a Greener Revolution (Report of the Task Force on Agriculture, 1972) Vol. I, p.1

2. Throughtout this paper "paddy" refers both to paddy and rice. Where production and productivity figures are given in tonnes and kilograms, the reference is to rice.

3. The basic data relating to taluks are not given to save space. The analysis is confined to 98 of the 103 taluks leaving out all the three taluks of the Nilgiris, Kodaikanal and Yercaud where the cropping pattern is distinctly different from the rest of the taluks.

4. B.S. Minhas and P. Vaidyanathan "Growth of Crop Output in India, 1951-4 to 1958-61" Journal of the Indian Society of Agricultural Statistics, Vol. XVII, 2, 1965.

Their frame of analysis is the following:

Crop	Weight	Proportion of Area in year		Yield in Year	
		t_o	t_1	t_o	t_1
C_1	W_1	C_{1o}	C_{1t}	Y_{1o}	Y_{1t}
C_2	W_2	C_{2o}	C_{2t}	Y_{2o}	Y_{2t}
:	:	:	:	:	:
C_n	W_n	C_{no}	C_{nt}	Y_{no}	Y_{nt}

The C_i's are the Crops : W_is the constant price weights assigned to different crops represented by three year average all India wholesale prices. C_{1o} and C_{1t} are proportion of area occupied by different crops in years o and t. Y_{1o} and Y_{1t} are yields, again in the two terminal years, o and t.

Denoting:

P_o = Crops output in year o
P_t = Crop output in year t
A_o = Gross Crop area in year o
A_t = Gross Crop area in year t

the following definitions are obtained:

$$P_o = A_o \sum_i W_i C_{io} Y_{io}$$

$$P_t = A_t \sum_i W_i C_{it} Y_{it}$$

Minhas and Vaidyanathan work with constant prices (W_is) and consequently the analysis is conducted in terms of "real" output. An analysis in real terms has certain distinct advantages. But in a study of changes in agricultural operations and output an important question to be examined is the extent to which changes in prices affect them. The main difference between their method and one followed in this paper is that in the latter price changes are explicitly taken into account by using base period and terminal period prices (W_{io} and W_{it}).

5. $P_t - V_o$ is the same as $P_t - P_o$ in the Minhas-Vaidyanathan method and hence the decomposition of $P_t - V_o$ is also the same as the decomposition of $P_t - P_o$.

6. This is because according to the 1961 Census any person who had regular work of more than one hour a day throughout the greater part of the season was treated as a "worker". On the other hand in the 1971 Census only a person working for the greater part of the season was treated as a "worker". The elastic definition of 1961 gave scope to include housewives, students etc., who put in occasional work in agriculture (and other forms of unorganised activity) as "workers". These categories of persons were treated as "non-workers" in the Census of 1971.

7. For a detailed discussion of this point see C.T. Kurien and Josef James: Economic Change in Tamil Nadu : A Regionally and Functionally Disaggregated Analysis, (Report of an ICSSR Project) Vol.I, Ch.IV.

8. The World Agricultural Census 1970-71 : Tamil Nadu based on total enumeration gives more comprehensive information than the NSS Reports, but only about operational holdings.

9. Lorenz curves for the three years show a slight reduction in the inequality of ownership, especially between the 8th and 26th rounds, but not much between the 16th and 26th rounds.

10. For details of land reforms in Tamil Nadu see, K.S. Sonachalam, Land Reforms in Tamil Nadu (New Delhi, Oxford and IBM Publishing Company, 1970) and G. Venkataramani, Land Reforms in Tamil Nadu (Madras Sangam Publishers, 1973).

11. Malcom S. Adiseshiah in his Preface to G. Venkataramani Land Reforms in Tamil Nadu.

12. Reported in G. Venkataramani, op.cit. p.45

13. State Planning Commission Towards a Greener Revolution Vol.II, p.65.

14. For instance see the Twenty per cent Sample Survey on Land Holding and related matters reported in the 1961 Census.

15. Reported in R.K. Sampath and Jayalakshmi Ganesan, Economics of Dry Farming in Tamil Nadu (Madras, Sangam Publishers 1972) Ch.4.

16. See C. Muthiah, The Gree Revolution - Participation by Small Versus Large Farmers, Indian Journal of Agricultural Economics, Jan-March 1971, and Nanjamma Chinnappa, Adoption of the New Technology for Paddy Cultivation in the Survey Area: North Arcort District (Mimeographed).

17. On the basis of information gathered from the Season and Crop Reports (various issues) the following calculations have been made of the gross earnings per hectare for different cereals.

	Yield in Kg. per hectare	Price per quintal Rs. P	Gross Earnings per hectare Rs. P.
1. Cholam	(Dry-550)	67. 87	373.29
	(Wet-1200)		944.40
2. Cumbu	(Dry-600)	62. 96	377.76
	(Wet-1500)		944.40
3. Ragi	(Dry-800)	61.83	494.64
	(Wet-1800)		1112.94
4. Paddy	1747	95.22	1663.49

The yield of millets in dry and wet conditions is taken from R.K. Sampath and Jayalakshmi Ganesan Op.cit. p.57-59.

18. Source of data : Tamil Nadu : An Economic Appraisal-1975 Part I, p.26.

19. Calculated from figures made available by the Directorate of Agriculture, "Impact of Institutional Finance for Agricultural Development in Tamil Nadu" as reported in R.K. Sampath and Jayalakshmi Ganesan op.cit. p.93.

20. Source of data: Tamil Nadu : An Economic Appraisal-1975 Part I, p.26.

21. This comes from the title of the Report of the State Planning Commission's Task Force on Agriculture.

22. The trend line was fitted by least square estimation.

23. For a detailed examination of this point see C.T. Kurien "Tamil Nadu Economy 1974" Bulletin of the Madras Institute of Development Studies, February 1976.

24. In 1974-75 there was a sharp decline in the production of paddy on account of the drought but the 1975-76 harvest has been a bumper one.

25. R.K. Sampath and Jayalakshmi Ganesan, op.cit. p.75

26. See Calculations in Note 17.

27. For a discussion of minor irrigation schemes in Tamil Nadu see, G. Venkataramani, Minor Irrigation in Tamil Nadu (Madras: Sangam Publishers, 1974).

28. See R.N. Bhatty: "Inequality and Poverty in Rural India" in Sankhya Series, C, June-December 1974.

> recent examination by the present writer on poverty in Tamil Nadu also shows that the incidence of poverty is very high among the cultivators in the State. About 55 per cent of the cultivators do not get a nutritionally adequate diet and over 60 per cent of the cultivators come below the poverty line if the reference point is minimum levels of living.

29. For a detailed analysis of the process of urbanization in Tamil Nadu, See C.T. Kurien and Josef James, op.cit. Ch.7.

Table 1 : Percentages of Gross Cropped Area (GCA = 100 per cent) Under Cultivation of Major Crops

	1951-52	1955-56	1960-61	1965-66	1968-69	1973-74
Paddy	28.14	32.15	34.39	35.41	37.07	35.35
Cholam	11.28	10.99	10.57	10.74	10.12	8.38
Cumbu	8.45	8.26	6.68	5.66	6.61	5.24
Ragi	5.24	5.05	4.97	4.66	4.35	3.44
Total Cereals	62.09	64.73	63.86	63.23	61.76	57.54
Total Pulses	7.41	6.52	5.82	5.63	6.35	8.67
Groundnut	12.27	10.56	11.90	13.52	13.47	14.85
Sugarcane	0.80	0.71	1.11	1.43	1.76	2.43
Cotton	3.10	3.68	5.41	4.54	3.99	3.91
Other Crops	14.33	13.80	11.90	11.65	12.67	12.60
Total	100.00	100.00	100.00	100.00	100.00	100.00
Total gross cropped area (in '000 hectares)	6,357	6,867	7.321	7,066	6,914	7,650

Table 2 : Area Under Major Crops in '000 Hectares

Year	Paddy	Cholam	Cumbu	Ragi	Groundnut	Sugarcane	Cotton
1951-52	1789 (100)	717 (100)	537 (100)	333 (100)	779 (100)	51 (100)	197 (100)
1955-56	2208 (123.4)	755 (105.3)	567 (105.6)	347 (104.2)	724 (92.9)	49 (96.1)	253 (128.4)
1960-61	2518 (140.7)	774 (107.9)	489 (91.1)	364 (109.3)	871 (111.7)	81 (158.8)	396 (201.0)
1965-66	2502 (139.9)	759 (105.9)	400 (74.5)	329 (98.8)	955 (122.4)	101 (198.)	321 (162.9)
1968-69	2563 (143.3)	700 (97.6)	457 (85.1)	301 (90.4)	931 (119.4)	172 (337.3)	276 (140.1)
1973-74	2704 (151.1)	641 (89.4)	401 (74.7)	263 (79.0)	1136 (145.6)	186 (292.2)	299 (151.8)

(Figures within brackets show indices with 1951-52 = 100)

Table 3 : Production of Major Crops in '000 Tonnes

Year	Paddy	Cholam	Cumbu	Ragi	Groundnut	Sugar-cane	Cotton
1951-52	2129 (100.0)	461 (100.0)	265 (100.0)	305 (100.0)	782 (100.0)	332 (100.0)	292 (100.)
1955-56	3002 (141.0)	486 (105.4)	235 (88.7)	335 (109.8)	840 (107.4)	340 (102.4)	311 (106.5)
1960-61	3559 (167.2)	631 (136.9)	301 (113.6)	360 (118.0)	1057 (135.2)	686 (206.6)	374 (128.1)
1965-66	3524 (165.5)	513 (111.3)	235 (88.7)	292 (95.7)	823 (105.2)	955 (287.7)	301 (103.1)
1968-69	3550 (166.7)	495 (107.4)	288 (108.7)	292 (95.7)	798 (102.0)	1514 (456.0)	250 (85.6)
1973-74	5595 (262.8)	563 (122.1)	297 (112.1)	287 (94.1)	1163 (148.7)	1373 (413.6)	341 (116.8)

(Figures within brackets show indices with 1951-52 = 100)

Table 4 : Index Number of Productivity (Yield Per Hectare) (1951-52 = 100)

Year	Paddy	Cholam	Cumbu	Ragi	Sugar cane	Ground nut	Cotton
1951-52	100	100	100	100	100	100	100
1955-56	114.3	99.7	84.6	105.5	100.7	115.6	83.1
1960-61	118.7	126.5	124.9	108.0	130.1	121.5	112.8
1965-66	118.4	104.7	119.3	97.1	113.3	85.8	114.2
1968-69	126.2	109.6	127.6	106.1	135.6	85.5	110.1
1973-74	171.0	154.3	207.9	130.0	141.6	104.8	136.5

Table 5 : Paddy - Annual Growth Rates

Year	Area	Output	Yield
1952-53	- 2.52	- 5.08	- 2.61
1953-54	19.32	19.32	6.98
1954-55	3.75	8.41	4.51
1955-56	2.27	7.33	4.93
1956-57	4.89	8.16	3.08
1957-58	- 2.16	1.26	3.42
1958-59	0.31	- 4.68	-4.83
1959-60	1.84	6.34	4.27
1960-61	8.76	6.78	-1.81
1961-62	0.79	9.77	8.98
1962-63	5.04	2.99	-1.95
1963-64	- 1.77	-3.68	-1.99
1964-65	0.26	4.12	3.85
1965-66	- 4.73	-12.69	-8.33
1966-67	7.47	7.70	-0.07
1967-68	- 1.08	1.45	9.36
1968-69	-11.17	- 7.70	-2.60
1969-70	- 1.76	13.01	6.05
1970-71	4.68	24.80	19.27
1971-72	2.04	5.89	3.73
1972-73	5.98	5.04	0.87
1973-74	-5.16	0.47	4.14
Average Annual Growth Rates			
1951-52 to 1973-74	2.33	7.40	3.23
1951-52 to 1960-61	4.53	7.46	2.08
(1951-52 to 1961-62)	4.19	8.35	2.94
1960-61 to 1968-69	- 0.77	-0.03	0.79
(1960-61 to 1970-71)	0.47	4.07	3.4
1968-69 to 1973-74	1.1	11.52	7.09

Table 6 : Millets (Cholam, Cumbu and Ragi)
Annual Growth Rates

Year	Area	Output	Yield
1951-52			
1952-53	4.91	-26.58	-27.31
1953-54	14.41	31.04	15.61
1954-55	-10.22	26.51	37.54
1955-56	- 2.40	-15.86	-14.56
1956-57	- 1.62	1.51	2.56
1957-58	- 6.95	8.48	12.80
1958-59	8.11	3.35	- 3.80
1959-60	1.97	9.73	8.12
1960-61	-1.93	- 2.05	- 0.70
1961-62	-2.09	- 3.64	- 0.21
1962-63	-2.20	1.12	3.26
1963-64	-2.96	- 6.04	- 3.61
1964-65	0.94	- 2.62	- 2.08
1965-66	-2.56	- 9.73	- 8.62
1966-67	-1.15	13.94	15.52
1967-68	-1.64	- 5.41	- 3.58
1968-69	0.76	- 4.96	- 3.72
1969-70	7.75	13.95	3.42
1970-71	-4.46	- 2.94	7.66
1971-72	-2.80	-11.53	- 9.14
1972-73	-4.94	1.99	3.43
1973-74	-5.91	6.80	32.96
Average Annual Growth Rates			
1951-52 to 1973-74	-0.81	0.51	2.56
1951-52 to 1960-61	0.[illegible]	2.81	1.98
(1951-52 to 1961-62)	-0.04	2.08	1.76
1960-61 to 1968-69	-1.30	-2.10	0.58
(1960-61 to 1970-71)	-0.78	-0.79	0.62
1968-69 to 1973-74	-2.10	-1.32	7.82

Table 7 : Percentage growth rates of area under cultivation irrigation, paddy and millets

Years	Gross cropped area	Gross irrigated area	Area under	
			Paddy	Millets
1951-52 to 1973-74	20.3	48.6	51.1	-17.8
1951-52 to 1959-60	10.8	20.5	29.4	4.5
1959-60 to 1969-70	1.6	9.8	8.8	- 5.3
1969-70 to 1973-74	4.8	12.3	7.4	-16.9

Table 8 : Progress of HYV Programme

Year	Paddy		Millets	
	Area under HYV (in lakh hectares)	Area under HYV as % of total area	Area under HYV (in lakh hectares)	Area under HYV % of total area
1969-70	11.42	45.35	0.91	4.39
1970-71	18.19	69.01	1.69	8.53
1971-72	22.45	83.46	3.56	18.92
1972-73	21.80	76.46	4.50	25.30
1973-74	21.43	77.96	4.76	26.39

Table 9 : Fertiliser consumption in Tamil Nadu
(in lakh tonnes)

Year	N	P	K	Total
1961-62	0.33	0.08	0.04	0.45
1966-67	0.85	0.44	0.32	1.31
1969-70	1.48	0.42	0.33	2.23
1970-71	1.73	0.72	0.51	2.96
1971-72	2.14	0.72	0.61	3.47
1972-73	1.79	0.53	0.48	2.82
1973-74	1.95	0.76	0.72	3.37

Table 10 : Cropping pattern in Tamil Nadu : 1961 and 1971 State and District Levels

Districts	Year	P	M	R
Chingleput	1961	71.80	11.55	16.64
	1971	71.15	8.16	20.69
South Arcot	1961	38.50	25.85	35.64
	1971	43.05	21.45	35.50
Salem Dharmapuri	1961	10.93	52.71	36.35
	1971	13.19	44.91	41.90
Coimbatore	1961	12.38	38.76	48.84
	1971	11.67	40.35	47.98
The Nilgiris	1961	6.66	6.44	86.70
	1971	5.89	5.84	88.27
Tiruchirappalli	1961	26.27	42.63	31.08
	1971	27.19	43.95	28.86
Thanjavur	1961	26.27	42.63	31.08
	1971	27.19	43.95	28.86
Madurai	1961	77.66	2.89	19.43
	1971	73.63	21.92	4.45
Ramanathapuram	1961	37.29	24.83	37.88
	1971	40.86	15.27	43.87
Tirunelveli	1961	28.46	22.35	49.16
	1971	23.02	17.51	59.47
Kanyakumari	1961	53.92	N	46.08
	1971	51.07	N	48.93
Tamil Nadu	1961	34.39	28.95	36.66
	1971	35.67	26.76	37.55

N : Negligible.

Table 11 : Distribution of the Taluks showing significant Variation in Cropping Pattern

Type of taluks (on the basis of principal crops)	Total number of taluks in the type	Taluks showing significant changes	Column 3 as % of column 2
1	2	3	4
P - Taluks	44	5	11.4
M - Taluks	19	7	36.8
R - Taluks	1	-	-
TP - Taluks	34	8	23.5
Total	98	20	

Table 12 : Pattern of Change in the Cultivation of Major Crops

(Taluk level)

Crops	Increase	Decrease
Paddy	58	40
Millets*	24	70
Other Crops	51	47

* Total adds up to only 94 because the 4 taluks in Kanyakumari have only negligible area under millets.

Table 13 : Relative contribution of different elements to the growth of crop output 1960-62 to 1969-71

DISTRICTS	$\frac{V_t - V_o}{V_o}$ Overall Growth	Area effect	Yield effect	Cropping pattern effect	Interaction effect	Real Growth	Pure price effect	Price yield effect	Price Cropping pattern effect	Total Interaction effect	Monetary growth
1	2	3	4	5	6	7=3+4+5+6	8	9	10	11	12=8+9+10+11
Chingleput	134.84	0.71	27.55	-0.39	-1.26	26.61	57.07	13.85	3.56	-1.09	73.39
South Arcot	135.93	4.75	11.42	1.83	0.10	18.10	78.47	2.28	1.51	-0.36	81.90
North Arcot	90.54	-1.08	13.79	2.71	1.09	16.51	76.02	6.14	0.83	0.50	83.49
Salem	60.81	-9.21	-3.06	11.70	-1.32	-1.89	99.00	-2.38	6.38	-1.11	101.89
Coimbatore	92.01	-7.24	12.63	-3.44	-2.18	-0.23	95.51	8.26	-1.80	-1.74	100.23
Tiruchirapalli	96.50	.21	-0.68	0.71	0.15	0.39	100.37	-1.84	0.92	0.16	99.61
Thanjavur	104.57	12.51	0.59	-2.56	-0.73	9.81	92.11	-0.03	-0.94	-0.95	90.19
Madurai	73.15	-7.31	8.34	-6.47	-0.29	-5.73	106.14	2.72	-3.26	0.13	105.73
Ramanathapuram	108.78	-1.28	3.20	3.28	3.00	8.20	87.03	0.13	1.97	2.67	91.30
Tirunelveli	86.19	-17.17	23.02	-3.19	-2.95	-0.29	85.52	14.47	2.26	-1.96	100.29
Kanyakumari	49.77	-13.60	-15.13	1.07	-0.20	-27.86	138.47	-11.97	1.70	-0.34	127.86
State	101.47	-0.49	7.29	0.96	0.46	8.22	86.57	3.75	1.25	0.21	91.78

Table 14 : Percentage share of Net State Domestic Product by Industrial Origin at 1960-61 prices and composition of the Labour Force

	1950-51	1955-56	1960-61	1965-66	1970-71
I. Percentage share of NSDP					
1. Agriculture and allied activities	52.4	52.3	51.9	43.3	42.0
2. Mining and Manufacturing	12.7	14.1	17.7	23.7	24.2
3. Commerce, Transport, Communications and Other Services	34.9	33.6	30.4	33.0	33.8
	100.0	100.0	100.0	100.0	100.0
II. Labour Force :					
1. Primary Sector	62.4		63.3		64.8
2. Secondary Sector	14.2		14.7		14.9
3. Tertiary Sector	23.4		21.9		20.3
	100.0		100.0		100.0

Table 15 : Distribution of Ownership of Land (National Sample Survey)

Sl. No.	Size class of household ownership holding	Cumulative Percentage					
		Households			Area Owned		
		Rounds 8	16	26	8	Rounds 16	26
1.	upto o.99*	62.74	60.42	60.53	3.08	3.43	4.45
2.	1.00-2.49	76.56	77.51	78.40	13.03	17.19	20.23
3.	2.50-4.99	86.88	88.84	89.79	29.36	36.92	42.07
4.	5.00-7.49	92.60	93.38	94.55	44.47	50.42	58.02
5.	7.50-9.99	95.49	95.94	96.54	55.37	61.15	67.28
6.	10.00-14.99	97.52	97.82	98.55	66.03	72.24	80.27
7.	15.00-19.99	98.42	99.02	99.27	72.73	81.88	87.00
8.	20.00-24.99	98.87	99.36	99.54	77.21	85.44	90.25
9.	25.00-29.99	99.21	99.56	99.69	81.21	88.21	92.47
10.	30.00-49.99	99.71	99.83	99.91	89.09	93.21	96.95
11.	50.00 & above	100.00	100.00	100.00	100.00	100.00	100.00

* Households owning either no land or land less than 0.005 acre are in the size class.

Table 16: Distribution of Operational holdings of land
(National Sample Survey)

Sl. No.	Size class of households operational holdings	Cumulative Percentage					
		House holds			Area operated		
		Rounds			Rounds		
		8	16	26	8	16	26
1.	Upto 0.99*	53.60	56.43	56.04	2.88	3.19	3.76
2.	1.00-2.49	70.23	74.01	76.73	13.32	16.32	21.93
3.	2.50-4.99	83.95	87.73	89.18	31.89	39.82	44.85
4.	5.00-7.49	91.10	93.07	94.64	48.10	54.85	62.37
5.	7.50-9.99	94.88	96.04	96.85	60.34	66.58	72.29
6.	10.00-14.99	97.48	98.30	98.59	72.12	79.02	83.24
7.	15.00-19.99	98.50	99.09	99.34	78.74	85.20	90.00
8.	20.00-24.99	99.02	99.43	99.66	83.09	88.58	93.70
9.	25.00-29.99	99.29	99.63	99.81	85.89	91.04	95.73
10.	30.00-49.99	99.71	99.90	99.97	91.65	95.73	98.88
11.	50.00 & above	100.00	100.00	100.00	100.00	100.00	100.00

* Households operating either no land or land less than 0.005 acre are included in the size class.

Table 17: Ploughs and Tractors in use in Tamil Nadu

Year	Wooden Ploughs (in thousands)	Iron Ploughs (in thousands)	Tractors
1951	2,890	57	NA
1956	2,851	77	822
1961	3,223	207	934
1966	3,423	348	3,278
1974	3,677	610	7,170

Table 18 : Number of Pumpsets energised

Year	Pumpsets (Oil)	Electric Pumpsets	
	Number	Number	Connection load (K.W)
1956	29,761	32,440	1,37,651
1961	36,832	1,17,695	4,30,905
1966	42,852	2,56,594	8,88,873
1970	NA	4,70,776	15,95,809
1973	NA	6,49,241	21,93,158
1974	NA	6,81,258	NA

Table 19 : Expenditure on Irrigation

Plan period	Expenditure on Minor irrigation (Rs.lakhs)	Expenditure on Major and Medium irrigation (Rs. lakhs)
I Plan	290	2015
II Plan	439	1756
III Plan	2257	3146
Annual Plans		
1966-67	1054	438
1967-68	1103	409
1968-69	890	407
IV Plan		
1969-70	660	479
1970-71	667	490

Table 20 : Size and Cropping Characteristics

No.	Size Class (Hectares)	Gross Cropped area as percentage of operated area	Irrigated area gross as percentage of sown area	Area under foodgrain as percentage of grass cropped area	Area under non-foodgrains as percentage of gross cropped area
1.	0-05	106.42	83.88	78.94	21.06
2.	0.5-1	101.54	68.26	74.71	25.29
3.	1-2	96.46	59.19	72.12	27.88
4.	2-3	93.80	54.85	70.39	29.61
5.	3-4	91.86	51.35	68.44	31.56
6.	4-5	90.05	49.78	67.74	32.26
7.	5-10	86.20	47.58	66.46	33.54
8.	10-20	76.80	42.75	62.71	37.29
9.	20.30	65.60	39.16	59.77	40.23
10.	30-40	58.27	40.73	58.58	41.42
11.	40-50	53.83	35.00	54.52	45.48
12.	above 50	43.46	21.15	29.63	70.37

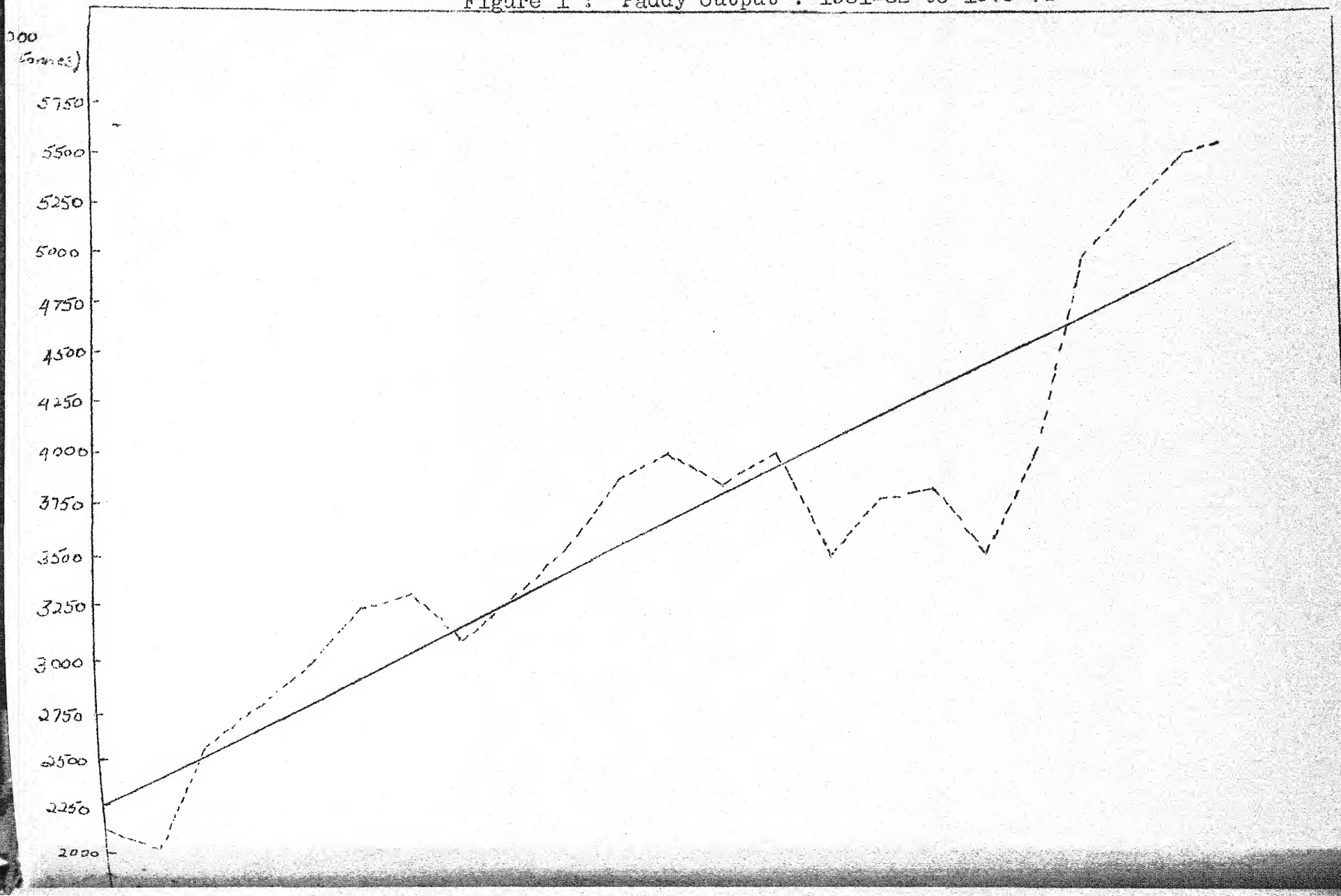
Source : World Census of Agriculture, 1970-71. Tamil Nadu p.84, 85.

Table 21 : Sources of Irrigation (Percentage of net irrigated area)

No.	Size Class (Hectares)	Canals	Tanks	Tube Wells	Wells	Other Sources
1.	0-05	33.98	45.44	1.37	18.31	0.90
2.	0.5-1	35.60	37.23	1.52	24.85	0.80
3.	1-2	35.62	32.39	1.65	29.5[illegible]	0.77
4.	2-3	35.29	30.06	1.91	31.99	0.75
5.	3-4	31.83	30.29	2.06	34.[illegible]7	0.85
6.	4-5	31.64	29.74	2.34	35.48	0.80
7.	5-10	31.49	28.44	2.49	36.[illegible]1	0.87
8.	10-20	28.53	27.56	2.77	39.[illegible]4	1.20
9.	20-30	26.82	28.79	2.27	40.[illegible]8	1.14
10.	30-40	29.26	31.00	2.51	36.[illegible]6	1.17
11.	40-50	35.54	25.62	3.33	33.[illegible]1	2.70
12.	above 50	34.15	30.74	2.82	26.[illegible]7	6.22

Source : World Agricultural Census, 1970-71, Tamil Nadu p. 83

Figure 1 : Paddy output : 1951-52 to 1973-74



PRODUCTIVITY AND RESOURCE STRUCTURE

A Case Study of Agricultural Development of Gujrat, India

Baldev Singh*

Problem Setting:

Agricultural production, say of an economy, can be increased by two approaches : (i) given the agricultural productivity per unit of land, by putting additional land under cultivation, often referred as extensive cultivation approach, and (ii) given the cultivable land, by increasing the agricultural productivity per unit of land (to be hereafter referred to as agricultural productivity), often referred as intensive cultivation approach. From political, economic as well as administrative point of view, it is the extensive cultivation approach which is relatively convenient and, hence, the favourite of agricultural planners. No wonder, Indian agricultural strategy has revolved around this soft approach during the decade of fifties; the first decade of Indian planning era. However, it is the latter approach, a relatively difficult option, on both political and administrative grounds, which the agricultural planner has to be prepared to reckon with, particularly while formulating the long-run agricultural strategy; although often a dodged, at least in the initial years of Planning. And, it is this agricultural productivity aspect of the agricultural planning strategy, which forms the prime focus of this paper.

Now, the achieved levels of agricultural productivity are reflective indices of the various variants of technological horizons inculcated, through experience as well as formal training, in various sections of the farm community. An increase in productivity level of an economy, therefore, tantamounts to an improvement in its farm community's technological horizons; a difficult task indeed. For, it calls for, besides disbursement of the technological knowledge through administrative channels, say agricultural extension agencies, the creation of favourable objective conditions for the reception, absorption and implementation of this knowledge. And, it is this task of creation of favourable objective conditions, which determines whether, what, and how much to produce and, in turn, to invest, which abounds with numerous problems, particularly political and administrative. Hence, the need to analyse the resource structure the fountain of these objective conditions on the part of the agricultural planner; the other foci of

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Accordingly, the twin-objectives of this paper are as under : (i) to analyse the resource structure of agriculture, and changes therein, dueing the development process; and (ii) to relate these structural features, and changes therein, with agricultural productivity.

Agricultural development experience of sixties of Gujarat, when cast in factor analysis and static comparative framework with reference points revolving around 1961 and 1971, reveals five salient structural characteristics. Three of these are technology variants: traditional, intermediate and modern; and the other two institutional variants: agrarian structure and sectoral size. And, it is the set of technology variants which commands a dominant position in the explanation of structural variations, more so, in agricultural productivity. Within the technology set, it is, however, the modern technology variantwhich is primarily responsible for changes in agricultural productivity; and it is the traditional technology variant which is mainly associated with changes in resource structure. No wonder, Indian agricultural strategy of sixties has primarily revolved around the modern technology variant; a preserve of progressive, usually large capitalist farmers. Notwithstanding the marginal tilt in emphasis in the agricultural strategy around late sixties in favour of small farmers, the increase in agricultural productivity is still primarily attributable to modern technology adopting farms. This may as well be due to the failure on the part ofthe government to improve the agarian structure; a pre-requisite for the absorption of modern technology by the group of farmers practicising traditional and intermediate technology.

The paper is organised into four sections : Section I gives a brief description of the methodology. Section II lists the variables and data sources. Section III presents the results and attempts their interpretation. Further reflections of the analysis with an eye on implications for agricultural strategy are listed in the concluding remarks, Section IV.

Section I - Methodology:

Macro growth situations, particularly those dealing with agricultural development, are known for their intricate mutual interdependence behaviour. Nurkse's vicious cycle of poverty is a typical illustrative case. The use of multivariate analysis for such situations of mutual interdependence, the pre-requisite of which is the absence of interdependence amongst the set of independent causal variables,

has, therefore, to be taken with a pinch of salt. And probably this explains the mushroom growth of sophisticated econometric models. The huge amount of data requirements of such models, often lacking in developing countries, makes their operational viability rather difficult (even if huge costs involved are ignored). Hence, the need to look for a simple, but viable, alternative.

The technique of factor analysis, based on the principle of mutual interdependence , seems to provide a simple, though relatively crude, alternative. The basic structural features of the total situation under examination are reflected by a set of indices, often referred in literature as factors, aspects, components, or dimensions. These indices, hereafter referred to as factors, are formed from the observable variables using the following mathematical principles : (i) "Those variables that are most clearly intercorrelated are combined within a single factor; (ii) The variables allocated to a given factor are those that are most nearly independent of the variables allocated to the other factors; (iii) The factor are derived in a manner that maximizes the percentage of the total variance attributable to each successive factor(given the inclusion of the preceding factors); and (iv) The factors are independent (uncorrelated with each other)".1/

Let us assume that we have n (i = 1, ... n) agricultural variables to represent the m (j = 1, ... m) underlying structural features of the agricultural situation in each of the N (k = 1, ... N) spatial units, say districts. The factor analysis model may, then, be written in matrix notation form as under:

$$Z_{(n,N)} = A_{(n,m)} \times F_{(m,N)}$$

where Z = the matrix of variables (of order n x N)
However, the observations of variables are normalized, Z_{ik} (i = 1, ... n; k = 1, ... N), with respect to their arthmetic mean and standard deviations $\left(Z_{ik} = \frac{X_{ik} - \bar{X}}{\sigma X_i} \right)$

A = the aspect matrix (of order n x m) or matrix of factor loadings (or connection coefficients) a_{ij} (i = 1, ...n; j = 1, ..m)

F = the matrix of factors (of order m x N) with elements f_{jk} (j = 1, ... m; k = 1, .. N).

1/ Adleman, Irma, and Morris, Cynthia T. (1967, p.132)

The solution of the model may be obtained by a no. of standard techniques, 1/ the pricipal-factor technique is probably the most widely used. This technique, however, does not guarantee that the solution will be a unique solution i.e. a solution which is invariant to changes in the composition of sample of variables used to characterize each factor. Now, a number of techniques are available to get a unique solution ; the most pupular being the varimax solution. 2/

A few words about the interpretation of the final unique solution; invariably the matrix A. Its constituent, the a_{ij} th coefficient, shows the net correlation (often called j^{th} factor loading or connection coefficient) between the j^{th} factor and the i^{th} observed variable. The $(aij)^2$ represents the proportion of the total unit variance of the variable i which is explained by factor j, after allowing for contribution of other factors. The sum of the squared factor loadings, or the 'communality", of each variable indicates the proportion of the total unit variance explained by all the factors taken together. 1/ And the sum total of the effect of all the variables belonging to a factor indicates the proportion of the total unit variance explained by that factor. Further, the grouping of variables into common factors may reasonably be done by assigning each variable to that factor with which it shows the closest linear relationship i.e., that factor in which it has the highest loadings. In a border-line situation, where loadings of a variable in two factors are very close, the variable may be assigned to that factor with which it is, on a priori grounds, judged to have the closest affinity.

Section II : Variables, Coverage and Data Base:

Broadly speaking, the four building blocks of agricultural resource structure are represented by four resource inputs : land, labour, capital and water. In an economy, these resource inputs may manifest themselves in the garb of a number of variables depending on the prevailing mix of natural conditions, man-made institutions and the development stage attained by the economy. Our selection of variables to proximate these resource inputs has, however, been further conditioned by the availability of data relating to each of the districts 1/ of Gujrat around the triennial of 1960-61 and 1970-71 the two reference points (arbitrarily) chosen for the purposes of comparative-static inter-district analysis. In all, twenty variables are selected to represent the resource structure of Gujarat's agriculture.

1 & 2 For details, See, Harman (1968).

The land resource input is represented by seven variables : (i) Net sown area (N.S.A.) (ii) Cropping intensity; (iii) Operational size of the holding; (iv) Proportion of area owned and self-cultivated to total cultivated area ; (v) Number of holdings below four hectares to total number of holdings; (vi) Concentration ratio of operational land holdings; and (vii) Number of joint cultivating holdings as a proportion of total number of holdings (only for 1971). The labour resource input is proximated by three variables : (i) Work-force engaged in primary sector (activities) as a proportion of total labour force; (ii) Male agricultural work-force per '1000 hectare' unit of N.S.A.; and (iii) Literacy rate of rural male population. The water resource input is represented by four variables: (i) Normal rainfall (mm); (ii) Irrigated area as a proportion of N.S.A.; (iii) Irrigated area by wells[1] to total irrigated area; and (iv) Number of pump-sets per '100 hectare' unit of irrigated area. And, the capital resource input is proximated by five variables: (i) Animal draught power[2] per '1000 hectare' unit of N.S.A. (No.); (ii) No. of ploughs[3] per '1000 hectare' unit of N.S.A.; (iii) No. of tractors per 'lakh hectare' unit of N.S.A. ;(iv) Fertilizer consumption[4] per '100 hectare' unit of gross cropped area (Kgs.); and (v) Area under high yielding varieties (H.Y.V.) of food crops as a proportion of corresponding total cropped area (only for 1971).

The reference period of these variables varies with the nature of the variables flow or stock. Since annual information on flow variables, such as fertilizer consumption, irrigation, etc, is available; triennial annual average of years around 1960-61 and 1970-71 is estimated (to minimize the effect of random weather, climate and other exogenous factors). For stock variables, such as tractors, ploughs, land holdings, etc. it is the year in the nearest vicinity of these periods for which information is available, say quinquinnium livestock census of 1961 & 1972.

Having identified and estimated the variables representing the agricultural resource structure, a few words on the estimation of agricultural productivity are called for. Agricultural production is the sum total of production produced by the spectrum of agricultural activities varying from crop cultivation to fish cultivation. Traditionally, however, crop cultivation holds the dominant position and is, often, used as a proxy for agricultural production. Owing to district-wise data limitations, we had to contend with the sum total of production produced by the seven important crops. Four of these are food crops: Wheat, Bajra, Jowar and Rice; and three non-food crops: cotton, groundnut

1/ Thus, the communality feature of factor analysis may be considered analogous to R^2 in the regression analysis.

and Tobacco. To account for the product quality variations, the location specific triennial average prices are multiplied with the corresponding quantity figures. And, estimates of agricultural productivity per hectare are obtained by dividing the sum total value of the set of seven selected crops by the corresponding cropped area. Further, these estimates are made temporally comparable by using constant prices, i.e. triennial average of 1969-70, 1970-71 and 1971-72.

Finally, a few words on the district-wise information base. Information has been scanned through both published and unpublished, often mimeographed, documents. The published sources consulted are as under : (i) Handbook of Basic Statistics : Gujarat, Bureau of Economics and Statistics, (yearly issues); (ii) Socio-economic Review; Gujarat, Bureau of Economics and Statistics (various issues); (iii) Quarterly Bulletin of Economics Statistics, Bureau of Economics and Statistics, Vol.III, No.3, July - September, 1963 and (iv) Gujarat Economic Association : Conference Papers (ed. by Vyas et.al.), Baroda, January,1971. A number of mimeographed documents referred are as per details: (i) Livestock Quinquinnium Census, Bureau of Economics and Statistics, 1972; (ii) Irrigation in Gujarat, Bureau of Economics and Statistics, 1974; (iii) Fact book on Man-power: Gujarat, Bureau of Economics and Statistics, 1973; (iv) District-wise Area, Production and Yield per hectare of Important Food and Non-food crops: Gujarat, Directorate of Agriculture; (v) Agricultural Census 1970-71: Estatistical Tables: Gujarat, Directorate of Agriculture; Vol. II; and (vi) Fertilizer Consumption, Directorate of Agriculture; (vii) Area under H.Y.V., Directorate of Agriculture.

Besides, a number of other, unpublished Statistics are obtained through the courtesy of Directorate of Agriculture, and Bureau of Economics and Statistics, Gujarat.

Section III: The factor Analysis : Results and Interpretation:

The results of factor analysis, computed [1] in standardised form with the help of principal factor technique and vari-max rotation procedure, are summarised in the matrix of common factor coefficients, the matrix A, presented, for 1961, in Table I and, for 1971, in Table 2. The listing of

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[1] Except the district of Dangs, for which information on no. of variables for 1971 was not available. Also, in 1971, district of Gandhinagar was merged with A'bad and Bulsar with Surat. Effectively, there are, therefore, 16 districts only.

the variables is according to their factor loadings (i.e. factor coefficients), except in the case of agricultural productivity variable which is of prime interest and, therefore, gets the allocation in the first row. Accordingly, Table 1 and 2, list, in the second row onwards, first the variables that have their highest loadings in Factor I, then those with highest loadings in Factor II, III, IV and V successively. Figures in brackets indicate the loadings in that factor to which each variable is assigned. These tables give, besides the factor loadings, two additional set of informations ; in the last column, it is the 'community' of each variable, and in the last row, it is the percentage variation explained by each factor.

Before we proceed to identify the individual factors specifed in the results of our statistical analysis, a few general highlights of the result may be noted. The set of five factors explain more than 90 per cent of the variations, on the one hand, in the agricultural productivity(per hectare) and, on the other, in the resource structure of agricultural sector as a whole. While factor compositions have remained, by and large, unaltered, changes are discernible in relative importance of factor roles during the decade of sixties.

FACTOR I : TECHNOLOGY VARIANT I - TRADITIONAL AGRICULTURAL TECHNOLOGY

Around two-fifth of the total variance of the set of variables selected to represent the resource structure of Gujarat's agriculture is explained by this factor alone. This factor is represented, as indicated by individual factor loadings, by five variables. Four of these variables which tend to stick together during the triennium of 1960-61 and 1970-71 are as under : (i) Animal traction power : No. of draught animals per 1000 hectare unit of net sown area(NSA); (ii) Animal drawn implements: No. of ploughs per '1000 hect' unit of NSA; (iii) Labour force: No. of male agricultural workers per '1000hect'. unit of NSA ; and (iv) Precipitation: normal rainfall (m m). The fifth variable is associated with land input. In 1960-61, it is cropping intensity. And, in 1970-71, it is no. of joint holdings to total no. of holdings.

1/ Wells include pump-sets as well.
2/ It is obtained in bullock pairs by giving equal weights of 0.5 to each of bullocks and 'he-buffaloes' and of 1.0 (unity) to camels.
3/ Ploughs include wooden and iron ploughs.
4/ Fertilizer consumption is obtained by adding with equal weights assigned to equal physical weights of N , $P_2 O_5$ and $K_2 O$.

The under currents of this factor tends to highlight the salient characteristics of an agricultural situation, in which agricultural economy, operating at or around low productivity equilibrium level, depends on (a) the vagaries of nature (Rain God) and (b) traditional cultivating technology, i.e., labour intensive bullock technology.[1/] Further, additions to agricultural production are made primarily by additions to land input. Accordingly, we find that inspite of the intensive land use, indicated by cropping intensity, yield per hectare remained unaffected by this factor in 1961. [1/]

With proper disbursement of agricultural know-how, it may, however, be possible to raise the low productivity equilibrium level. During the decade of sixties, Gujrat's agriculture got activated through two different, but complimentary, channels: (i) the agricultural extension service disbursed the latest know-how of crop production,[2/] and, probably more important, (ii) the stewardship towards co-operation provided by the intellectuals and political leadership of Gujarat.[3/] As a consequence, in 1971, we find that there is a tendency on the part of farmers to increase the size of cultivating unit through co-operative effort.[4/] (Note the positive association between the variable, representing the no. of joint holdings as a proportion of total no. of holdings, - a proxy variable for co-operation and other variables belonging to this factor).[5/] Also, that this factor has a significant association with agricultural productivity. However, only 12.3 percent of the variations in agricultural productivity are explained by this factor. Considering the structural importance of the factor, this limited achievement, although a feat in itself, tends to corroborate the belief that the potential to increase agricultural productivity with the traditional cultivating practices, given the institutional milieu, is either negligible or limited.

1/ Computations were done at IBM 360/44 computer system of Physical Research Laboratory, Ahmedabad. For able computer assistance author is indebted to Shri Suryanarayana of S.P.I.

FACTOR II: TECHNOLOGY VARIANT II - MODERN AGRICULTURAL TECHNOLOGY.

The most important determinant of agricultural productivity, explaining as much as 60 to 70 percent of its variations, is endowed in modern agricultural technology - a concomitant of dynamic agriculture - represented, in 1961, by Factor II and, in 1971, by Factor III. Its constituent variables, as would be expected, are as under:[1] (i) Human capital : Literacy rate of rural male population; (ii) Land augmenting capital : Fertiliser consumption per "100 hect." unit of gross cropped area (GCA); and (iii) Land - labour augmenting capital : (a) No. of tractors per "lakh hectare" unit of N.S.A. and (b) Area under high yielding varieties (H.Y.V.) of food crops to total area under these crops.

Production potential of modern technology is reasonably independent of the spatial bondages. Same is, however not true of its adopting. And it is for this reason, the structural importance of this factor varies amongst nations; increasing with advancement in developmental process. Gujarat's agriculture, a state of developing Indian economy, subscribes a limited role of this factor. It explains less than one-fifth of the variations in resources structure of its agricultural sector.

Factor I, together with Factor II, exemplifies an agricultural situation portrayed in dual economy models.[1] A miniature modern agricultural satellite, characterised by large sized farms concentrating on commercial production activities with the help of capital-intensive technology, is encircled by, but enjoying limited interaction with traditional massive subsistence agriculture. Probably, an outcome of inherited feudal structural relations of colonial past.

Even after independence, till recently, it was this small, but dynamic, agricultural satellite around which agricultural strategy of the country revolved.[1] It was in late sixties.[2] when Indian agricultural strategy went under metamorphosis. The new strategy for additional agricultural production lays, on the one hand, less emphasis on the direct productive role of modern capitalistic sub-agricultural sector and, on the other, more emphasis on the inter-action between modern[3] and traditional sub-sectors. Besides, lot of direct

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1/ Note the positive association amongst the variables of labour-land ratio, animal power, and ploughs.

subsidy, in the form of modern agricultural inputs, is being pumped into the traditional sub-sector.

Consequently, we find in 1971 compared to 1961 that, the role of modern capitalistic sector, to explain, both resource structure and productivity of agricultural sector, has not only been curtailed, but, in fact, has dwindled to a lower level. And that of traditional sub-sector has increased. Thus, highlighting the rightness of the recent agricultural strategy. However, the overall impact of this strategy on the composition of resource structure and agricultural productivity is marginal (note the changes in relevant figures). Indeed, it will be safe to sum up the agricultural development experience during the decade of sixties as having been oriented to help, besides helping the rich capitalist progressive class of cultivators,1/ the traditional farm community; though successful, successful in a small way.

Factor III: Agrarian Structure:

Structurally, the next important factor is identifiable with the cultivation base of agrarian structure, namely, land and, underlying underneath it, water. As an agricultural productivity determinant, its role is however, insignificant. Further, the behaviour of this factor during the decade of sixties reveal diquieting features. While as structural determinant it has improved its position (from 13 per cent in 1961 to 19 percent in 1971), as productivity determinant it retains its insignificant role.

In other words, the spate of agrarian legislations passed during the decade of sixties have failed to improve the objective conditions, conditioning the agricultural production, underlying the existing agrarian structure - an outcome of colonial feudal relations. On the other hand,

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1/ Note that less than one percent of the variations in agricultural productivity are explained by this factor.

2/ The spectacular success of high yielding Bajra crop in Gujarat is a pointer of the phenomenon. For details, see Rao (1975).

3/ The success story of Gujarat's co-operative ventures is highlighted by the Co-op. Dairy Projects, particularly the one located at Kaira.

4/ and 5/ Part of the explanation for cooperation may be to circumvent the legislations on aggrarion reforms. Non-availability of the relevant information in 1961, led to the exclusion of the variable from the set.

the hold of the existing agrarian structure appears to have strengthened.

An indepth analysis of the constituent variables of the factor is likely to uncover the undercurrents of the disquieting phenomenal features. The man-made institutional conditions, conditioning the supply of land services, are proximated by the following variables : (i) Land distribution pattern : concentration ratio ; (ii) Extent of small holdings; no. of holdings below four hectare to total no.of holdings; (iii) Extent of tenancy: proportion of area owned and self cultivated to total cultivated area; and (iv) Scale of operation: size of the cultivating unit. And the supply of underground water is approximated by the following two variables: (i) Degree of dependence on underground water: Irrigated area by wells to total irrigated area; and (ii) Extent of mechanisation of water lifting: No. of pumpsets per '100 Hect.' of gross irrigated area.

Interesting aggrarian relations - the building blocks of objective conditions - are discernible(Table 3). An increase in the scale of a farm-firm i.e. the size of cultivating unit, is accompanied, more so, when ownership of land lies with the cultivating, unit, by investment in capital intensive irrigation structures, namely, pumpsets. The obvious outcome being an assured, timely and adequate irrigation supplies, 1/ i.e. an increase in the degree of dependence on underground water supplies. Interesting, and probably more reverling, is the fact that these relationships get strengthened in situation where land is relatively evenly distributed amon st the cultivating units. 2/ Also, where there is less preponderance of small holdings. It is, thus, the amalagamation of a set of conditions which form the building blocks of favourable objective conditions for agricultural production. And, this set of conditions are represented by a framework of relatively even land distribution, with land ownership rights bestowed in the cultivating units which are of such operational scale as is economically as well technically viable and socially desireable.

1/ The role of these modern technology embodying capital assets in agricultural production, individually as well as collectively, is well established in growth literature relating to developing as well as developed nations.
See : for example, Rao, CHH (1975) and Hayami and Rutten (1971), Singh (1972) and Singh (1975).

The agrarian legislations passed during the decade of sixties, however, have failed to improve these conditions in any significant way. Infact, the status-quo, seems to have been maintained, except (i) that more area is reported to be under self-cultivation, (ii) that inter-district variations in these conditions have declined; and (iii) that dependence on mechanically lifted underground water has increased (Table -3). The outcome of a set of conditions represented by unequal land distribution coupled with unequal control over the limited underground water resources is obvious for agricultural production.[1] No wonder, the factor has no role to play viz-a-viz overall agricultural productivity.

Factor IV: Technology Variant III - Intermediate Agricultural Technology.

The next factor, in the declining order of structural importance, is identifiable with the intermediate agricultural technology; represented, often, by irrigation and land-use pattern. And, irrigation, together with production of relatively remunerative crops, is known for its role as a watershed between the age of livestock technology and that of tractor technology.[2] Being a technology variant, its favourable influence on agricultural productivity is obvious.

A detailed analysis of the constituent variables of the factor is likely to highlight the additional salient structural characteristics of the Gujrat's agricultural economy. These variables, representing each irrigation and land-use pattern, are as under: (i) Extent of irrigation: Irrigated area as a proportion of N.S.A.; and (ii) Land-use pattern: (a) Proportion of cropped area under nonfood crops and (b) cropping intensity. The relationships amongst these variables are revealing, more so, in 1961. For, and that is apparently surprising, two of the constituent variables, namely, extent of irrigation and preponderance of non-food crops, are inversly related. However, an examination of the crop-mix grown in the region highlights the rationale behind this, apparently spurious, relationship.

1/ According to Fei and Ranis, the dual economies "are characterized by the co-existence of two sectors: a relatively large and over-whelmingly stagnant subsistence agricultural sector, and relatively small but growing commercialed industrial sector".
See, Fei and Ranis (1964)

The important non-food crops of Gujarat are Cotton, Groundnut and Tobacco. And, the food crops are Bajra, Jowar, Rice and Wheat. With the exception of wheat crop, which is grown in Rabi season, all other crops are grown in Kharif season. And Kharif season coincides with the rainfall months of monsoon season. Further, irrigation availability also coincides with these months. In fact, in many parts of Gujarat, it has been noted, that wells as well as canals and tanks go dry in the Rabi season.[1] And, if drought situation prevails, even in Kharif season.[2] Given the scarce nature of water supply, its allocation, on rational grounds, is likely to favour such crop activities: (a) that have less water requirements, (b) that are grown in those months when water availability is reasonably sure, and (c) that are more productive. And on all the three counts, it is the non-food crops, particularly cotton and groundnut, that command a position of top ranking (Table 4). Obviously, these stake the first claim on the scarce water supply. As and when additional water supplies become available, these are allocated to various crop activities, other things being equal, according to the declining order of their productivity levels.

Economic rationality of the farmers, thus, provide the explanation for the complex relationship between intermediate agricultural technology and agricultural productivity on the one hand, and amongst the variables representing the intermediate agricultural technology, on the other.

Factor V: Sectoral size:

Structurally, the least important factor included in the analysis, accounting for about 6 per cent of the total variance and represented by net sown area and proportion of work force engaged in primary sector to total work force, is identifiable with the size of the agricultural sector. On the one hand, the size of a sector denotes the size of its market, and on the other, the quantum of the service supplies of the endowed sectoral resources. And, these, individually

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1/ The Community Development Programme and the Intensive Agricultural District Programmes, the two basic organs of the Indian Agricultural Development Strategy, are known for their bias towards big farmers. For details, see Appu(1974).

2/ It is around this period that a no. of schemes were introduced to help the small farmers, say the Small Farmers Development Agency.

3/ Farmers belonging to this sector, in day-to-day parlance, are, often, referred to as progressive farmers.

as well as collectively, are likely to have a favourable effect on the (value of) agricultural productivity: the former effecting the unit value of agricultural output and the latter affecting the yield per unit of land. The intensity of positive effect on agricultural productivity is, however, subject to overall developmental level of the sector(as well as the economy); which, in turn, depends on the technological horizon of its farm community. The positive, though nominal, influence of this factor on agricultural productivity in Gujarat, is, therefore, in line with our expectations (Table 1 & 2). Recall the ominious presence of unfavourable objective conditions faced by the dominant section of traditional conservative farm community of Gujarat.

Further, historically, the settlements of men-folk has been governed by natural conditions; favourable condition for production, say in agricultural sector, encouraging settlement of more men in the sector. To cope up with population pressures with passage of time, however, additional, obviously inferior, lands are brought under cultivation. Being of inferior quality, these lands command low productivity levels and can stand, in turn, low population pressure. The obvious outcome being the prevalence of inverse relation between the land under cultivation and labour force on the one hand, and land under cultivation and agricultural productivity, on the other. Gujarat's experience corroborate this (Table 1 and 2).

Section IV: Concluding Remarks:

Further reflections reveal interesting implications of the preceding analysis for an agricultural development strategy. A development strategy to be successful is invariably required to have at least, two perspectives : a short-run perspective and a long-run perspective. An Agricultural strategy concentrating almost all its energies on modern technology, and, therefore, ignoring the required Institutional reforms or implementing them half-heartedly may be allright to tide over the short-run pressures: its growth potential, particularly owing to the small operational base, is likely to be limited. Besides, it may lead to worsening of or, at least, dampening of the measures aimed at improving the inter-class economic differences to attain the most cherished development goal; development with equity.

For details, See, Meier (1964)

The long-run agricultural development strategy ought, therefore, to concentrate more at, besides developing the indigenous agricultural technology to suit the local climate and resource endowment structure, improving the objective conditions which determine whether, what and how much to produce and, in turn, invest. For, only this will help in the smooth reception, absorption, and implementation of indigenously developed improved agricultural technology by the cultivating community.

1/ The term well is used in a broad sense to include all the means of lifting or pumping out water from underground sources. For example, it covers man-muscle operated open wells ; animal power operated, persian wells; and mechanical power operated pump-set, tube-wells etc.

1/ Note the positive association of above mentioned two variables with this variable, proximated by irrigated area by wells to total irrigated area.

2/ Not the inverse association between the above set of variables with the set of variables representing concentration ratios and no. of holdings below 4 hect. to total no. of holdings.

1/ For details, See, Dhawan (1974).

2/ For details, see Singh (1972) Chapters 5 & 6.

1/ For details, see, Singh and Sharma (1975)
2/ Gujarat is a draught prone state. Indeed, 10 to the 19 districts are covered under the Draught prone Area Programme (DPAP)

TABLE - 1

ROTATED FACTOR MATRIX FOR AGRICULTURAL PRODUCTIVITY PER HECT. TOGETHER WITH 18 AGRICULTURAL RESOURCE INPUT VARIABLES : GUJARAT, 1960-61

Var No.	Description	Factor loading of Factors I	II	III	IV	V	Communality
1	2	3	4	5	6	7	8
1.	Productivity per hectare	-0.072 (.0052)	0.847 (0.717)	-0.069 (0.005)	0.425 (0.181)	0.181 (0.033)	0.941
2.	Cropping intensity	0.956	0.123	0.053	0.146	0.006	0.953
3.	Animal draught power per '000' hect. of NSA (No.)	0.873	0.086	0.011	0.264	0.329	0.948
4.	Ploughs per '000' hect. of NSA (No.)	0.837	0.284	0.163	0.177	0.326	0.945
5.	Male agricultural workforce per '000' hect. of NSA	0.761	0.449	0.214	0.196	0.322	0.969
6.	Rainfall in mm.	0.652	0.234	0.339	0.531	0.022	0.876
7.	Tractors per lakh hect. of NSA (No.)	0.143	0.889	0.113	0.041	0.158	0.850
8.	Fertilizers consumption per '000' hect. of GCA(Kgs.)	0.127	0.888	-0.152	0.162	0.016	0.854
9.	Literacy rate of rural male population (%)	0.136	0.693	0.509	0.002	0.229	0.810
10.	Concentration ratio of land holdings.	0.343	0.047	-0.873	0.083	0.022	0.889
11.	Self cultivated area to NSA (%)	0.031	0.111	0.852	0.204	0.131	0.800

1 2	3	4	5	6	7	8
12. Irrigated area by wells to total irrigated area.	0.137	0.184	0.805	0.055	0.225	0.704
13. No. of holdings less than 4 hect. to total no. of holdings (%)	- .653	0.354	-0.589	0.025	0.284	0.954
14. Pumpsets per 100hect. of G.I.A.	- .119	- .284	0.555	0.575	0.130	0.750
15. Holding size (hect.)	- .666	- .390	0.516	0.042	0.318	0.965
16. Irrigated area to N.S.A.(3)	0.014	0.007	0.048	-0.936	0.047	0.881
17. Proportion of area under nonfood crops.	- .519	0.424	0.270	0.478	0.274	0.826
18. Net sown area.(Hect.)	0.017	0.098	-0.016	0.034	- .963	0.939
19. Workforce in primary sector to total work force(%)	0.588	0.053	0.244	0.277	0.534	0.770
Percent variation explained	42.5	18.6	13.0	8.0	5.7	

Note:-

1. Figures in brackets indicate the factor to which each variableis assigned. Vrriables omitted because of (i) insignificant correlation: none (ii) Low high loading : none.
2. A variable having loading on two factors which are not significantly different is assigned to that factor to which it is judged to have closet affinity.
3. Percentage of overall variance explained by factors is 87.9. Percentage of variance explained by the last factor is 5.7.
4. Figures in the parenthesis of first row are respective square values.

TABLE - 2

ROTATED FACTOR MATRIX FOR AGRICULTURAL PRODUCTIVITY PER HECT. TOGETHER WITH 20 AGRICULTURAL RESOURCE INPUT VARIABLES : GUJARAT 1970-71

Var. No.	Description	Factor loadings of factor I	II	III	IV	V	Communality
1	2	3	4	5	6	7	8
1.	Productivity per hect.(Rs.)	0.350 (.123)	0.047 (0.002)	0.795 (0.632)	0.268 (0.072)	0.310 (0.096)	0.932
2.	Joint holdings(no.) to total no. holdings (%)	0.899	0.025	0.021	0.142	0.145	0.850
3.	Rainfall (in mm.)	0.881	0.308	0.156	0.006	0.056	0.899
4.	Ploughs per lakh hect.of NSA (no.)	0.881	0.089	0.003	0.164	0.372	0.949
5.	Animal draught power per'000' hect. of NSA (no.)	0.780	0.094	0.185	0.038	0.515	0.918
6.	Male Agr. workforce per'000' hect. of NSA	0.753	0.236	0.374	0.200	0.359	0.931
7.	Owned and self cultivated area to NSA (%)	0.097	0.880	0.281	0.265	0.004	0.933
8.	Irrigated area by wells to total irrigated area (%)	0.059	0.860	0.012	0.313	0.207	0.884
9.	Concentration ratio of land holdings	0.345	-0.827	0.221	0.229	0.072	0.909
10.	Pump-sets per'000' hect. of G.I.A.	0.218	0.824	0.043	0.416	0.116	0.915
11.	No. of holdings below 4 hect. to total no. of holdings(%)	0.591	-0.554	0.402	0.276	0.279	0.969
12.	Size of Holding	0.624	0.500	0.445	0.236	0.280	0.971

TABLE - 2(Contd.)

1	2	3	4	5	6	7	8
13.	Literacy rate of rural male population (%)	0.021	0.327	0.850	0.132	0.167	0.875
14.	Tractors per lakh hect. of NSA (No.)	0.013	0.383	0.824	0.142	0.000	0.846
15.	Fertilizers consumption per '00' hect. of GCA(Kgs.)	0.050	0.307	0.802	0.358	0.077	0.874
16.	Area under HYV to total area	0.150	0.130	0.604	0.158	0.565	0.748
17.	Proportion of area under non-food crops.	0.067	0.241	0.245	-0.877	0.103	0.902
18.	Cropping intensity	0.458	0.074	0.003	0.829	0.069	0.907
19.	Irrigated area to NSA (%)	0.099	0.291	0.645	0.532	0.193	0.831
20.	Net Sown Area (Hect.)	0.038	0.056	0.054	0.289	-0.894	0.890
21.	Work force in primary sector to total work force.	0.192	0.426	0.082	0.421	0.640	0.812
	Percent variation explained	39.3	19.0	15.9	8.9	6.0	

Note:- Figures in brackets indicate the factor to which each variable is assigned. V-ariables omitted because of: (i) insignificant correlation; none (ii) low high loading; non.

(2) A variable having loading an two factors which are not significantly different is assigned to that factor to which it is judged to have closet affinity.

(3) Percentage of overall variance explained by factors 89.3. Percentage of variance explained by last factor included 6.0.

Figures in the parentheses of first now are respective square values.

TABLE - 3

SELECTED SET OF VARIABLES RELATING TO AGRARIAN STRUCTURE OF GUJARAT : 1960-61 AND 1970-71

Sr.No.	Description	Mean values 1961	Mean values 1971	t-test for mean value
A	Land Resource:			
(i)	Size of the cultivating unit: (Hectares)	5.61 (5.24)	4.88 (4.20)	-0.79
(ii)	Concentration ratio of cultivating units.	0.48 (13.0)	0.46 (12.6)	-1.09
(iii)	No. of holdings below 4 hectares to total no. of holdings (%)	56.0 (41.2)	58.50 (34.3)	0.32
(iv)	Owned and self cultivated area to net sown area(%)	86.88 (13.7)	96.52 (6.9)	3.0^{x}
B.	Water Resource: Underground			
(i)	No. of pump sets per '00' hect unit of gross irrigated area.	6.77 (8.30)	39.23 (73.9)	4.26^{x}
(ii)	Irrigated area by wells to total irrigated area(%)	74.90 (22.43)	72.21 (24.25)	0.43

Sources:

A. For Land Resource:

(i) Statistical Tables Relating to Agriculture fensus 1970-71, Gujarat, Vol.II (Mimeograph)

(ii) Handbook of basic statistics: Gujarat, Bureau of Economics & Statistics, 1963-64.

(iii) Dadi, M.M., Occupational Structure and Productivity in Conference Papers, Gujarat Economic Association, 1971 (ed. Vyas, et al), p.84.

B. For water resource: (i) Irrigation in Gujarat: Bureau of Economic & Statistics, Gujarat, 1974 (Mimeograph).

Note:-(i) Figures are mean values of 16 districts of Gujarat, excluding Dangs, and after merging Gandhinagar in Ahmedabad & Bulsar in Surat.

(ii) Figures in brackets are corresponding values of coefficient of variation.

(iii) Figures with x mark are significant at 5 percent level of significance.

TABLE - 4

PRODUCTION PER HECTARE OF SELECTED SET OF IMPORTANT AGRICULTURE CROPS, GUJARAT 1961 & 1971

(Values in Rs. at 1969-71 prices)

Sr. No.	Name of the crop	Mean values *** 1961	Mean values *** 1971	t-test value	Season	Growth period Sowing	Growth period Harvesting	Water required (m.m.)
	FOOD-CROPS							
(1)	Bajri	201 (33)	543 (26)	+ 8.37	i) Kharif ii) Hot weather	June-July February-March	September* May	515 NA
(2)	Wheat	624 (38)	1390 (16)	+ 9.10		October	February	489
(3)	Jowar	202 (80)	268 (59)	1.13	i) Kharif ii) Rabi	July-Aug. Sept.	October-Nov.** January	252
(4)	Rice	647 (30)	912 (16)	+ 4.22		June-July	Oct.-Nov.	NA
	NON-FOOD CROPS							
(5)	Tobacco	2133 (46)	3747 (39)	+ 3.11		August	Jan-Feb.	NA
(6)	Groundnut	899 (21)	1166 (20)	+ 3.45		June-July	October	185
(7)	Cotton	821 (22)	1282 (66)	2.07		June-July	Feb-March	390

Note: * However Bajri is also grown in the month of June-July by some farmers.
** Jowar is a Kharif crop but some farmers have got success in growing it in Rabi season.
*** Mean values are 3 years averages around the year mentioned. + 't' values are significant at 5% level of significance (at 15 degrees of freedom).

Sources: (1) Joshi R.S. "Water requirement of crops in Gujarat", Magazine of N.M.College of Agriculture, Navsari, Vol. VI, No. 1, 1971-72

(2) Through the courtesy of

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REGIONALISATION FOR GROWTH AND BALANCE IN THE AGRICULTURAL SECTOR

(A Study of inter-district variations in agricultural productivity in Andhra Pradesh)

By

B. Sarveswara Rao & P.V. Sarma

SECTION - 1

INTRODUCTION

In the analysis of regional imbalances in the agricultural sector in India much attention has been paid in recent years to variations in output per hectare among the different State(s) and Districts. Such variations have also been studied over time, and attempts are made to analyse growth rates of output and their decomposition . However, the analysis of agro-climatic, technological and socio-economic factors contributing to variations in productivity has not received sufficient attention, and much less the study of the development process and changes in the type of farming situation in different regions (districts) with a view to evolving appropriate framework for regional and sectoral planning, and planning for overall agricultural growth with reduction in regional disparities. Since agriculture in its regional dismensions presents a high degree of heterogeneity in types of farming situation and development stages, public policies relating to investment in infrastructure, input supplied and research and provision of incentives to farmers will have to be carefully designed after paying adequate attention to the significant elements of this heterogeneity. The farming situation varies from region to region because of differences in agroclimatic conditions, availability and use of irrigation, level of technology employed, access to capital and inputs to farms of medium and small sizes and under different kinds of tennure, the attitude and aspirations of farmers, etc. Looking at the farming situation in a region in terms of the development process, it is possible to identify its major problem which may be stagnation in a static set up based on traditional and simple methods of cultivation, or transition from dry farming to irrigated farming, or spreading of new technologies (in both dry farming and irrigated areas), or stabilization of high levels and accelaration of output where a break-through in modern technology is already achieved and where farming has become a

its decomposition are not available for the three regions* of the State and there is only one source for information on the decomposition of output for the districts in the State (See Table 2). The differences among the regions and the districts in the State in respect of the growth of output can be seen from the data compiled for selected years as given in Table 3.

SECTION - 3

LEVELS AND GROWTH RATES OF OUTPUT PER HECTARE IN THE DISTRICTS AND REGIONS

The average output per hectare for Andhra Pradesh as a whole came to Rs. 477.51 for the two years 1960-61 and 1961-62, the East and West Godavari districts in the Coastal Andhra region showing the maximum amounts of more than Rs. 1150/- and the districts of Mehboobnagar, Adilabad and Karimnagar in the Telangana region showing rates of less than Rs. 250/-. The average productivity rate for the Coastal Andhra Region was Rs. 861.86 as compared with Rs. 377.64 for the Rayalaseema region and Rs. 278.49 for the Telangana region.

The per hectare output rates have substantially increased by 1974-75, the average for the State in this year being Rs. 716.23, which is about 50 percent more than the value in 1960-62. The highest rate of Rs. 1856.70 was attained in the West Godavari district of the Coastal Andhra Region. Two districts of the region showed considerable decline in growth, and the lowest positive rate of Rs. 230.20 was reported in the district of Adilabad in the Telangana region. The average per hectare output rose to Rs. 955.66 in Coastal Andhra, to Rs. 579.17 in Rayalaseema, and to Rs. 481.83 in Telangana. The co-efficient of variation, taking all the districts into account, is 59.73% in 1960-61, and 59.67% for the period 1960-62 and 63.91% in 1974-75 which indicates that the inter-district variations in per hectare output remained more or less the same (See Table 3).

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* A.P. consists of three distinct regions namely Coastal Andhra, Rayalaseema and Telangana. The agro-climatic and socio-economic characteristics of each region broadly justify its treatment as a distinct physical planning region.

It is however, worth noting that between the period 1960-62 and 1974-75 the gap between the absolute levels of output per hectare came to be substantially reduced when the Telangana region is compared with the Coastal Andhra region, the reduction in the gap being somewhat less when the Rayalaseema region is compared with the Coastal Andhra. This also means that the gap between the Telangana and Rayalaseema regions has increased to some extent. We have to make due allowance however, in this connection, for the abnormal fall in output in the Srikakulam and Visakhapatnam districts of the Coastal Andhra region.

It is also worth noting in this connection that the growth performance of the districts, judged by the two criteria of the quantity of additional output and the percentage rate of increase in output, gives a picture of great contrast. The Coastal Andhra districts except Srikakulam, Visakhapatnam and Nellore have achieved an additional output ranging between Rs. 300 to Rs. 700 per hectare, but the percentage increase among them varies only between 31 and 59. All the districts of Telangana and Rayalaseema regions except Chittoor, Nizamabad and Karimnagar have achieved much less additional output per hectare but the percentage rates of growth are higher. This is because the initial levels of output per hectare were low in these districts. A comparative study of growth rates of output in the districts and regions in such a situation can be misleading.

The above picture of interdistrict variations in agricultural productivity can also be looked at in a different but more meaningful way by analysing the distribution of districts according to size of per hectare output in the initial period 1960-62 and their shares in aggregate output in the same period and in 1974-75. The data are given in Table 4 which brings out clearly the fact that most of the districts in the relatively backward regions of Telangana and Rayalaseema consisting of 55 percent of the total number of districts in the State, are in the lowest two per hectare output groups in 1960-62. Their contribution to the total output was only 37.17 percent and it has increased to 39.86 percent by 1974-75. If allowance is made as already pointed out for the abnormal fall in output in Srikakulam and Visakhapatnam districts in 1974-75, there may be no increase in their share in the aggregate output. However, if the relative shares of the three regions are taken into consideration, the share of the Telangana region has improved with corresponding reduction in the share of Coastal Andhra.

SECTION - 4

ANALYSIS OR VARIATIONS IN PRODUCTIVITY

Productivity in agriculture in a region or a district as measured by the output per hectare is dependent broadly on (1) the levels of inputs used, and (2) resource base and infrastructure available. We have collected data relating to some important measures of these two factors and attempted to test the extent of this dependence for the two years 1960-61 and 1974-75. The data are shown in Tables 5 & 6.

The inputs we have selected for the analysis are (1) percentage of gross area irrigated to gross cropped area (2) percentage of area under HYV to gross cropped area, (3) intensity of cropping, (4) percentage of area under commercial crops to total cropped area, (5) fertilizer per hectare of cropped area, (6) agricultural credit per hectare of cropped area.

The indicators of resource base and infrastructure selected are (1) cultivated land per agricultural worker, (2) percentage of net area irrigated to net area sown, (3) tractors per 100 acres of cultivated land, (4) oil engines and electric meters per 100 acres of cultivated land, (5) road milage per 100 acres of cultivated land, (6) percentage of members in Primary Agricultural Credit and Multipurpose Co-operatives to total agricultural workers, (7) percentage of electrified villages and towns to total number of villages and towns.

For analysing the correlation between productivity as measured by per hectare output on the one side and the input levels, and resource base and infrastructure on the other side we have calculated an unweighted aggregate index number for inputs and an unweighted aggregate index of the resource base and infrastructure, taking the State average of each input and each indicator of resource base and infrastructure as 100. The Tables 5 and 6 give substantial evidence of the significant variation among the districts both in input levels and resource base and infrastructure levels, and their close correspondence to variations in per hectare output. Table 7 gives the values of the rank correlation.

The rank correlation coefficient between productivity and inputs for all the districts came to be 0.88 in 1960-61 and 0.86 for 1974-75. Similarly the rank correlation coefficient between productivity and resource base and infrastructure came to be 0.85 in 1960-61 and 0.81 in 1974-75. The rank correlation co-efficient between the inputs, and resource base and infrastructure was also found to be high, (i.e.) 0.88 in 1960-61 and 0.77 in 1974-75. The high correlation between these variables does not imply that there is a cause-effect relationship in only one direction. In fact, as farmers become prosperous in a region they will not only invest more on their own in inputs and infrastructure but will also be in a position to exert greater pressure on the Government to provide more infrastructural facilities and input supplies and services. This can of course happen only after the farmers have found a technical solution to productivity and have successfully raised productivity above a critical level. It is, however, reasonable to infer from the above analysis that, considering the spatial regional angle, levels of inputs and resource base and infrastructural facilities explain the levels of output in both the periods. It is also reasonable to suggest that, from the point of view of public policy, infrastructure and inputs are to be considered as sources of productivity in all situations. Further, it would appear that the 1974-75 picture of variations among the districts in the levels of inputs-and used and the available resource base infrastrucute is not very different from the picture in 1960-61. The rank correlation co-efficient of output in the two periods 1960-62 and 1974-75 is found to be as high as 0.89, implying that there is no change in the relative position of districts in respect of perhectare output. This means that during this period investments in the supply of inputs and infrastructure, taking both the private and public sector together into consideration, have contributed little to the reduction in inter-district differentials. It does also imply that Government investment has not adequately played the role to compensate for the in-adequacy of private investments in the relatively low productivity districts. Unfortunately data are not available for a detailed analysis of this aspect of public policy and its impact on agriculture in the districts. It is, therefore, possible to study the dynamics of interdistrict imbalances in agriculture by considering the stage or point reached in the tranisitional or transformation process in each district in 1960-62 and its further growth during the period 1960-62 and 1974-75, and relate this growth to the change in the levels of important inputs used. Such a study may hopefully throw light on the changing farm situation and the problems associated with them in the different district

SECTION - 5
REGIONALISATION FOR GROWTH AND BALANCE

The following Chart shows the distribution of districts according to level of per hectare output in the period 1960-62 and in 1974-75. It brings out clearly the facts relating to the growth performance of the different districts during the period of study. Data pertaining to the additional output achieved during the period 1960-62 and 1974-75 and in the levels of individual inputs used and resource base-infrastructure available in the years 1960-61 and 1974-75 are already given in the earlier Tables (See Tables 3,5 & 6). Table 8 gives the data relating to changes in the cropping pattern during the period. On the basis of these data it is now possible to group the districts according to the nature of agricultural growth during the period and consider the emerging types of farming situation and the kinds of problems associated with the new situations as reflected in the changes in inputs and infrastructure. As mentioned earlier agricultural development over a period of time may give rise to problems of stagnation or decline in ~~the~~ both the initially advanced as well as backward areas, problems of transition to improved agriculture and adoption of new technology and also problems pertaining to high rates of growth and accelaration of output based on wide acceptance of new technology. For a proper understanding of these dynamic aspects of agricultural growth, it is necessary to pay adequate attention to changes in the levels of inputs and infrastructure and in the cropping pattern.

The districts of East Godawari, West Godavari, Krishna and Guntur constitute a distinct group as indicated by the growth performance, the nature and extent of changes in inputs, and the nature and extent of infrastructure. Starting from initially high levels of per hectare output and thanks to extremely favourable agro-climatic conditions and of assured irrigation from the Godavari and Krishna river systems, they have achieved significant breakthrough in technology based on HYV and intensive application of fertilizers. Agriculture in these districts may be said to have reached an advanced stage which is dynamic and self sustaining in nature, and to be now facing problems of stabilisation of yields, drainage and water management, technological and socio-economic problems relating to further coverage of area under H.Y.V's in the Kharif season, and augmentation of water supply for the Rabi Season. As irrigated rice is the predominant crop of these districts, post harvest problems relating to rice have also become important. In Krishna and Gunture districts pulses and oilseeds also are important crops.

Nizamabad district in Telangana region and Chitoor district in Rayalaseema region constitute another group, which have achieved significant growth during the period. High performance of Nizamabad district was mainly due to increase in irrigation, fertiliserused and adoption of H.Y.V. paddy. The major crops of Nizamabad district continue to be rice, jowar and pulses and the further advance of the district in agriculture depends on extension of area under irrigation and H.Y.V as well as the adoption of modern dry farming technology for crops other than rice. In the case of Chitoor the high performance was primarly due to increased application of fertilisers and adoption of H.Y.V. paddy and substantial shift in cropping pattern to the high value groundnut crop.

7 Nellore district in Coastal Andhra has achieved considerable growth in per hectare output as a result of extension of irrigated area under paddy, application of fertilisers, HYV and intensity of cropping, but it continues to be in the same per hectare output group, which implies that despite some growth, farming under assured irrigation is still at a relatively low level and the productivity of jowar and other food crops, and oil seeds has to be raised.

The districts of Srikakulam and Visakhapatnam in Coastal Andhra region constitute another district group indicating a stationary situation. Rainfall plays a crucial role in these districts and affects irrigated area and intensity of cropping. The problem of the districts is essentially one of increasing the area under assured irrigation under tanks and wells, through utilisation of ground water and other minor irrigation sources, and increasing the productivity of dry crops, especially cereals other than rice, pulses and groundnut.

Cuddapah and Karimnagar which are among the less advanced districts on the basis of 1960-62 levels of output have shown remarkable progress during the period under study, thanks to significant increase of investment in all inputs, although they still lag behind the Coastal Andhra districts very much. In both the districts the area under irrigated rice is still below 25 percent of the cropped area, and jowar and groundnut, continue to be the next important major crops. The problem of the districts is essentially one of increasing the area under irrigated rice to the extent possible and improving productivity of jowar, groundnut and other dry crops.

Five districts of the Telangana region and two districts of the Rayalaseema region namely Medak, Hyderabad, Nalgonda, Warangal, Khammam, Anantapur and Kurnool constitute a district group whose growth performance is small on account

PART - I

DISTRIBUTION OF DISTRICTS ACCORDING TO LEVEL OF PER HECTARE OUTPUT IN 1960-62 & 74-75

Output level in 1960-62	Output level in 1974-75	Rs.250 & below.	Rs.250 to Rs.500/=	Rs 500 to Rs.750/=	Rs.750 to Rs.1000	Rs.1000 to Rs.1250	Rs.1250 to Rs.1500	Rs 1500 to Rs.1750	Rs.1750 to Rs.2000/=
		1	2	3	4	5	6	7	8
1. Rs.250 & below		Adilabad	Mehboobnagar	Karim-nagar					
2. Rs.250 - Rs.500			Kurnool Anantapur Hyderabad Medak Warangal Nalgonda Khammam	Cuddapah					
3. Rs.500 - R .750				Nellore		Nizamabad Chittoor			
4. Rs.750 - R 1000				Srikaku-lam Visakha-patnam		Guntur	Krishna		
5. Rs 1000 - Rs 1250								East Godavari	West Godavari

of inadequate investment in inputs and infrastructure. Agriculture in these districts is mainly dependent on rainfall, and the major problem of these districts is therefore improved dry farming. ~~In all these districts is therefore improved dry farming.~~ In all these districts jowar is the major cereal crop and paddy is next in importance. Pulses are also important crops in all the Telengana districts. Oilseeds particularly groundnut and caster, are the major non-food crops. The problem of these districts is therefore, one of extension of assured irrigation wherever possible and extensive application of dry farming techniques. In a sense these districts may be considered to be in the early stage of transition to improved farming as indicated by the levels of inputs used.

Finally, the remaining two districts namely Mahboobnagar and Adilabad present a dismal picture of stagnation with virtually no change in the levels of per hectare output and inputs. They represent broadly a picture of traditional dry farming based on simple technology and functioning as part of a survival system of economy. A break through even one element of improved farming has yet to take place in these districts.

SECTION - 6

CONCLUSION

The above analysis of productivity changes with reference to the significant inter-district variations during the period 1960-62 and 1974-75, is intended only as an exercise to focus attention on the dynamic aspects of agriculture in the State of Andhra Pradesh. The problems of further development in the regard to changes in infrastructure, inputs and cropping pattern in the different districts discussed above have to be considered only as problems tentatively identified and broadly suggestive of the direction of change required. Effective strategies for development of agriculture in the different

The Government of Andhra Pradesh has always given high priority to agriculture in the State and has paid a great deal of attention to development strategies for the three broad regions in the State with some reference to individual districts. The State Fifth Plan has broadly indicated the strategies and lines of action in each of the regions. The action areas indicated for the Coastal Andhra region are drainage in delta areas, stimulating semi-stagnant parts of the ~~drainage-in~~ delta districts, more intensive agriculture in upland areas with possibilities of irrigation, and special attention to tribal areas and drought prone areas. For the Rayalaseema region agriculture will be the lead sector of development for the next decade; and the strategies indicated are extension of irrigation facilities to the fullest extent possible, water management, shift from low value millets to high value crops, adoption of new dry farming technolgies and special attention to groundnut and cotton with a view to promote Rayalaseama specialisation in these crops. As regards the Telangana region, the lines of action indicated are further exploitation of surface and ground water resources, water management, shift from millets to commercial crops like groundnut, cotton and tobacco, soil conservation and improvement of dry farming, with emphasis on research, demonstration and extension.

These broad strategies for the development of the agricultural sector in the three regions have to be further examined from the point of view of the situations at the district and local levels. The approach we have adopted in this paper for analysing inter-district variations in productivity over time in-order to identify the emerging types of farm situation and the problems associated with them may be an useful approach for suggesting more definitive lines of action. The Government of Andhra Pradesh has also been actively engaged in Area Development planning based on detailed data collected for Blocks and Taluks in each district (Resource Inventory for each region) with a view to identify the lead sector at the Taluk level and also growth centres and service centres. The Government also hopes to prepare comprehensive perspective plans for the three regions. The integration of Area Development Planning and Agricultural Sector Planning at the district level and below will arise as one of the important tasks in this matter.

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TABLE - 1

GROWTH RATES OF AGRICULTURAL OUTPUT IN ANDHRA PRADESH

YEAR	COMPOUND RATE OF % GROWTH	PERCENTAGE CONTRIBUTION OF			
		Area	Yield	Cropping Pattern	Interaction
1950-53 to 1971-74	2.76	19.94	37.85	22.42	19.79
1951-53 to 1954-56	7.57	36.54	43.67	12.74	7.05
1956-58 to 1959-61	0.75	130.52	212.72	10.18	7.62
1950-53 to 1958-61	3.69	25,35	52.25	11.17	11.23
1961-63 to 1964-66	0.92	93.42	7.10	204.04	17.72
1966-69 to 1971-74	3.11	5.31	77.63	17.01	0.05

Source: Agro-Economic Research Centre, Andhra University Waltair, 1976. Report on the study of Agricultural Development in Andhra Pradesh 1950-51 to 1973-74. Appendix Tables

TABLE - 2

DECOMPOSITION OF THE GROWTH RATE OF AGGREGATE CROP OUTPUT IN THE DISTRICTS OF ANDHRA PRADESH (1956-64 to 1964 - 72)

Cate-gory.	Distts.	Index of crop output 1964-72 (56-64) =100	Growth rate of output	Growth rate of area	Weighted growth rate of crop yield.	Weighted shift rate of crop pattern	Produce of the growth rates of Area & weighted yield	Area & weighted crop	Crop pattern and yield	Area and weighted crop patten and yiedl
			(go)	(ga)	(gwy)	(gwc)	$(g_{a(wy)})$	$(g_{a(wc)})$	$(g_{(wcy)})$	$(g_{(g_{a(wcy)})})$
I.	Mahbubnagar	151.20	6.4686	0.0312	5.8244	1.0152	0.0145	0.0025	-0.4181	-0.0010
	West Godavari	147.99	5.9989	0.3911	3.8840	1.5748	0.1215	0.0492	-0.0213	-0.0000
	Khammam	146.00	5.7499	3.1194	1.1694	0.6972	0.2918	0.1740	0.2134	0.0594
	Warangal	142.31	5.2892	2.1488	2.7561	0.3406	0.4738	0.0585	-0.4170	-0.0716
	Karimnagar	135.88	4.4850	0.3084	4.1077	0.3155	0.1013	0.0077	0.3473	-0.0035
	Chittoor	128.39	3.5488	1.1340	0.3871	1.7330	0.0351	0.1572	0.0937	0.0085
	Cuddapah	118.70	2.3378	-0.1856	0.2530	2.3919	-0.0037	-0.0355	-0.0835	0.0012
	Medak	117.32	2.1650	-0.6071	2.3203	1.7141	-0.1127	-0.0832	-0.1206	0.0544
	Kurnool	116.76	2.0856	0.4194	-1.6222	3.2585	0.0544	0.1093	-0.0146	-0.0004
	Nizamabad	115.20	1.9004	0.0828	1.2304	0.8174	0.0082	0.0854	-0.2437	-0.0016
II.	Guntur	113.63	1.7043	1.2337	-0.5947	1.1473	-0.0587	0.1132	-0.1242	-0.0122
	Krishna	111.28	1.4095	0.5389	0.2400	-0.1532	-0.0103	0.0497	-0.0786	-0.0033
	Adilabad	111.26	1.4074	1.4050	0.0893	-0.1740	0.0100	-0.0191	0.0832	0.0093
	Nalgonda	110.14	1.2676	0.0414	-0.2753	1.1459	-0.0009	0.0037	0.3516	0.0011
	East Godavari	102.38	0.6723	0.3158	0.2166	0.2121	0.0054	0.0078	-0.1810	-0.0045
	Hyderabad	105.24	0.2804	0.1270	0.3378	0.0202	0.0334	0.0002	-0.2062	-0.0020
	Visakhapatanam	100.60	0.0746	1.1234	-0.7578	-0.1331	-0.0681	-0.0119	-0.0712	-0.0064
III.	Srikakulam	95.77	-0.0592	0.7000	-0.5914	0.2767	-0.0891	0.0155	-0.0506	0.0084
	Nellore	95.10	-0.6115	-0.9805	-2.1957	2.8053	0.1564	-0.1998	0.3091	0.0230
	Anantapur	78.70	-2.6621	1.7649	-2.2602	1.4773	0.3191	-0.2085	0.2618	0.0369
	Andhra Pradesh	115.04	1.8801	0.4153	0.2385	1.2220	0.0079	0.0406	-0.0429	-0.0014

Source; ,P.V; (1977) "Demand for fertilizers in Andhra Pradesh", Ph.D thesis submitted to the Andhra University, Waltair.

TABLE - 3

LEVEL OF PER HECTARE OUTPUT AT CONSTANT (1960-61) PRICES IN THE DISTRICTS OF ANDHRA PRADESH

District	1960-61	1961-62	1964-65	1969-70	Average of 1960-61 and 1961-62	1974-75	Increase between 1960-62 & 74-75	% increase
1	2	3	4	5	6	7	8	9
1. Srikakulam	809.58(4)	960.58(5)	868.38(5)	680.82(7)	886.50(4)	680.40(9)	-206.10	-23.25
2. Visakhapatnam.	663.23(6)	978.83(4)	853.92(7)	681.74(6)	828.68(5)	627.77(10)	-200.91	-24.24
3. East Godavari.	1083.36(1)	1290.90(1)	1305.41(2)	1093.81(2)	1188.74(1)	1580.88(2)	392.14	32.99
4. West Godavari.	1082.74(2)	1249.93(2)	1502.13(1)	1504.18(1)	1167.00(2)	1856.70(1)	689.70	59.10
5. Krishna	969.52(3)	1015.96(3)	1097.37(3)	955.28(3)	992.98(3)	1302.66(3)	309.68	31.19
6. Guntur	761.80(5)	780.90(6)	867.83(4)	742.92(5)*	771.35(6)	1082.59(5)*	311.24	40.35
7. Nellore	516.23(9)	553.24(9)	508.29(9)	667.83(8)*	535.31(9)	748.95(7)*	213.64	39.91
Coastal Andhra	808.67	913.32	902.95	699.86	861.86	955.66	93.80	10.88
8. Kurnool	306.48(12)	268.17(18)	345.35(16)	398.26(13)*	287.37(13)	404.93(16)*	117.56	40.91
9. Anantapur	367.52(11)	297.64(14)	350.42(14)	298.65(17)	332.83(11)	498.68(12)	165.85	49.83
10. Cuddapah	454.75(10)	413.05(15)	484.94(10)	530.66(10)	433.78(10)	688.98(3)	255.20	58.83
11. Chittoor	651.17(7)	559.21(8)	862.32(6)	843.59(4)	603.60(8)	1002.23(6)	398.63	66.04
Rayalaseema	405.07	350.42	448.10	486.65	377.64	579.17	201.53	53.37

* The output of Ongole district is distributed to the districts of Guntur, Nellore & Kurnool in the proportion of area transferred from each district.

Contd...2

TABLE - 3 (CONTD.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
12. Hyderabad	276.98(13)	283.88(16)	324.08(17)	301.76(16)	280.63(14)	461.31(14)	170.68	60.82
13. Nizamabad	628.24(8)	668.22(7)	757.99(8)	571.43(9)	648.93(7)	1126.87(4)	477.94	73.65
14. Medak	265.81(14)	366.02(11)	391.64(12)	317.55(15)	314.49(12)	457.51(13)	143.02	45.48
15. Mehboobnagar	184.98(20)	231.29(20)	235.74(20)	255.73(20)	208.38(20)	302.83(19)	94.45	45.33
16. Nalgonda	228.57(15)	319.90(13)	278.36(18)	285.73(18)	274.54(15)	345.80(18)	71.26	25.96
17. Warangal	196.18(19)	335.02(12)	399.79(11)	405.33(12)	265.33(16)	363.69(17)	98.36	37.07
18. Khammam	223.28(16)	280.91(17)	386.62(13)	526.26(11)	252.71(17)	448.84(15)	196.13	77.61
19. Karimnagar	200.28(18)	294.57(15)	349.38(15)	359.17(14)	247.46(18)	556.31(11)	308.85	124.81
20. Adilabad	204.60(17)	236.70(19)	270.18(19)	266.90(19)	220.59(19)	230.20(20)	9.61	4.36
Telangana	242.52	313.91	343.65	399.53	278.49	481.83	203.34	73.02
Andhra Pradesh	452.14	502.41	554.80	518.65	477.51	716.23	238.72	49.99
Co-efficient of variation(%)	59.73	60.49	58.11	61.29	59.67	63.91		

TABLE - 4

DISTRIBUTION OF DISTRICTS ACCORDING TO SIZE OF PER HECTARE OUTPUT IN 1960-62 AND THEIR SHARES IN AGGREGATE OUTPUT IN 1960-62 AND 1974-75.

Level of per hectare output during 1960-62	Regions	Districts	% distribution of districts		PERCENTAGE DISTRIBUTION OF AGGREGATE OUTPUT			
				Cumulative percentage	1960-62	Cumulative percentages	1974-75	Cumulative percentage
Less than Rs.250/= per hectare	Telangana	1. Mahboobnagar 2. Adilabad 3. Karimnagar	15	15	8.53	8.53	9.97	9.97
Rs.250/= to Rs.500/=	Telangana	4. Khammam 5. Warangal 6. Nalgonda 7. Hyderabad 8. Medak	25	40	13.23	21.76	14.23	24.20
	Rayala-seema	9. Kurnool 10. Anantapur 11. Cuddapan	15	55	15.41	37.17	15.66	39.86
Rs.500/= to Rs.750/=	Telangana	12. Nizambad	5	60	3.91	41.08	5.01	44.87
	Rayala-seema	13. Chittor	5	65	5.42	46.50	6.08	50.95
	Coastal Andhra	14. Nellore	5	70	6.68	53.18	5.90	56.85
Rs.750/= to Rs.1000/=	Coastal Andhra	15. Guntur 16. Visakha-patnam 17. Srikakulam 18. Krishna	20	90	30.71	83.89	25.84	81.69
Rs.1000/= to & above.	Coastal Andhra	19. West Goda-wari 20. East Goda-vari.	10	100	16.11	100.00	17.31	100.00
	Coastal Andhra		35	35	53.50		49.04	
	Telangana		45	80	25.67		29.22	
	Rayalaseema		20	100	20.83		21.74	

TABLE - 5

COMPARATIVE POSITION OF THE DISTRICTS IN ANDHRA PRADESH WITH REFERENCE TO SELECTED INDICATORS OF DEVELOPMENT 1960-61

Selected Indicators of development	Unit	A.P.	Srikakulam	Visakhapatnam.
(1)	(2)	(3)	(4)	(5)
I. Resource Base and Infrastructure				
1. Cultivated land per Agri.worker	Acres	2.54 (100.00)	1.07 (42.13)	1.09 (42.91)
2. % of net area irrigated to net area sown.	%	27.11 (100.00)	59.25 (218.55)	44.90 (165.62)
3. Tractors per 100 Acres of Cultivated land.	Nos	0.0054 (100.00)	0.0015 (27.78)	0.0200 (370.37)
4. Oil Engines & Electric motors per 100 acres of cultivated land.	"	0.1564 (100.00)	0.0806 (51.53)	0.1101 (70.40)
5. Road mileage per 1000 acres of cultivated land.	Miles	0.39 (100.00)	0.57 (146.15)	0.80 (205.13)
6. % of members in Primary Agricultural credit and multi-purpose co-operatives to total agricultural workers.	%	11.21 (100.00)	10.88 (97.06)	14.22 (12.69)
7. % of Electrified villages & towns to total no. of towns & villages.	%	11.86 (100.00)	4.63 (39.04)	5.21 (43.92)
	TOTAL:-	100.00	88.89	130.14
II. INPUT USE.				
1. % of gross area irrigated to gross cropped area.	%	27.96 (100.00)	57.99 (207.40)	43.31 (154.90)
2. % of area under HYV to Gross cropped Area.	%			
3. Intensity of cropping.	%	93.68 (100.00)	119.31 (127.56)	106.61 (113.90)
4. % of area under commercial crops to total cropped area.	%	17.64 (100.00)	19.16 (108.62)	22.04 (120.94)
5. Nitrogeneous Fertilisers used per hectare cropped.	Kg.	12.45 (100.00)	4.61 (37.03)	9.73 (78.15)
6. Agricultural credit by Primary Ag. credit & Multi-purpose Co-operatives per hectare cropped.	Kg.	15.35 (100.00)	19.64 (128.02)	50.16 (326.89)
	TOTAL:-	100.00	121.73	158.96

TABLE - 5(Contd.)

III.Productivity.

1. Value of Agriculture produce per hectare cultivated.	Rs.	453.22 (100.00)	809.81 (178.68)	628.66 (138.7)
2. Value of Agricultural produce" per Agricultural worker.		466.13 (100.00)	350.25 (75.14)	277.67) (59.57)
TOTAL:-		100.00	126.91	(98.94)

TABLE - 5 (Contd...(2)

		East Godavari	West Godavari	Krishna	Guntur	Nellore	Kurnool	Anantapur
(1)		(6)	(7)	(8)	(9)	(10)	(11)	(12)
I.	1.	1.39 (54.72)	1.70 (66.93)	2.06 (81.10)	2.38 (93.70)	2.62 (103.15)	4.47 (175.98)	3.90 (153.54)
	2.	64.20 (236.81)	74.18 (273.63)	67.29 (243.21)	29.61 (109.52)	40.71 (150.17)	7.77 (28.66)	8.60 (31.72)
	3.	0.0157 (290.74)	0.0290 (537.04)	0.0237 (438.89)	0.0035 (64.81)	0.0124 (229.63)	0.0021 (38.89)	0.0016 (29.63)
	4.	0.3061 (195.72)	0.3386 (216.50)	0.1815 (116.05)	0.1020 (65.22)	0.1319 (84.34)	0.0316 (20.20)	0.1444 (92.33)
	5.	0.82 (210.26)	0.54 (138.46)	0.40 (102.56)	0.39 (10 .00)	0.40 (102.56)	0.37 (94.89)	0.28 (71.79)
	6.	24.29 (216.68)	24.30 (216.77)	23.21 (207.05)	9.61 (85.73)	11.63 (103.75)	11.39 (101.61)	9.25 (82.52)
	7.	30.74 (259.19)	34.45 (290.47)	35.97 (303.29)	25.32 (213.49)	9.79 (82.55)	14.30 (120.57)	24.36 (205.40)
TOTAL		237.72	248.54	213.87	104.63	132.30	82.96	95.27
II.	1.	62.92 (225.04)	77.38 (276.75)	68.33 (244.38)	26.97 (96.47)	45.94 (161.31)	8.18 (29.26)	10.69 (38.23)
	2.							
	3.	117.32 (125.37)	111.88 (119.56)	105.69 (112.94)	107.15 (114.50)	89.72 (95.88)	95.49 (102.04)	100.29 (101.98)
	4.	15.31 (86.79)	11.63 (65.93)	8.34 (47.28)	15.98 (90.59	6.78 (38.44)	31.32 (177.55)	29.75 (168.65)
	5.	14.09 (113.17)	15.92 (127.87)	27.04 (217.19)	8.78 (70.52)	4.67 (37.51)	1.98 (15.90)	2.04 (16.39)
	6.	71.22 (464.09)	63.01 (410.63)	46.97 (306.12)	8.50 (55.39)	14.48 (94.36)	3.61 (23.51)	9.93 (64.73)
TOTAL:		202.89	200.15	185.68	85.49	86.10	69.65	78.00

TABLE -5(Contd.(2)

III.1.	1083.36 (239.04)	1082.74 (238.90)	969.52 (213.92)	761.80 (168.09)	516.33 (113.93)	306.48 (67.62)	385.14 (84.98)
2.	611.47 (131.18)	748.86 (160.22)	806.41 (173.00)	738.46 (157.57)	547.31 (117.42)	554.20 (118.89)	607.47 (130.32)
TOTAL.	185.11	195.56	193.46	162.83	115.67	93.25	107 .65

(1)	Cuddapah (13)	Chittor (14)	Hyderabad (15)	Nizamabad (16)	Medak (17)	Mahaboonag (18)
I. 1.	2.86 (112.59)	1.71 (67.32)	2.67 (105.12)	2.26 (88.98)	2.75 (108.27)	4.48 (176.38)
2.	24.62 (90.82)	33.81 (124.71)	10.92 (40.28)	38.62 (142.46)	17.84 (65.81)	9.36 (34.53)
3.	0.0014 (25.32)	0.0110 (203.70)	0.0019 (35.19)	0.0032 (59.26)	0.0007 (12.96)	0.0008 (14.81)
4.	0.1414 (90.41)	0.6495 (415.28)	0.2223 (142.14)	0.8502 (32.10)	(0.1370 (87.60)	0.1157 (73.98)
5.	0.44 (112.82)	0.58 (148.72)	0.50 (128.21)	0.56 (143,59)	0.30 (76.92)	0.24 (61.54)
6.	8.48 (75.65)	10.13 (90.37)	5.91 (52.72)	8.38 (74.75)	7.57 (67.53)	6.78 (50.56)
7.	17.55 (147.98)	27.88 (235.08)	8.44 (71.16)	6.43 (54.22)	4.53 (38.20)	3.40 (28.67)
TOTAL:-	93.74	183.69	82.11	85.04	65.32	63.06

TABLE - 5 (Contd(3)

(1)	Cuddapah (13)	Chittor (14)	Hyderabad (15)	Nizamabad (16)	Medak (17)	Mahaboonag (18)
II.1.	27.96 (100.00)	39.64 (141.77)	11.90 (42.56)	41.56 (148.64)	17.97 (64.27)	10.04 (35.91)
2.						
3.	78.69 (84.09)	87.97 (84.01)	80.12 (85.62)	86.83 (92.78)	77.22 (82.52)	75.65 (80.86)
4.	28.31 (160.49)	26.70 (151.36)	18.94 (107.37)	14.60 (182.77)	11.68 (66.21)	16.74 (94.90)
5.	5.19 (41.69)	4.29 (34.46)	4.55 (36.55)	37.23 (290.04)	3.32 (26.67)	3.60 (28.93)
6.	2.45 (15.94)	12.95 (84.38)	6.60 (43.00)	21.10 (137.52)	11.32 (73.75)	4.99 (32.53)
TOTAL	95.19	99.20	63.02	172.15	62.68	54.62
III.1.	454.75 (100.34)	651.17 (143.68)	276.98 (61.11)	628.24 (138.62)	265.81 (58.65)	184.98 (40.82)
2.	526.74 (113.00)	451.22 (96.80)	298.92 (64.13)	573.32 (123.00)	595.56 (63.41)	335.32 (87.07)
TOTAL	106.67	120.24	62.62	130.81	61.03	56,38

TABLE - 5 (Contd(4)

(1)	Nalgonda (19)	Warangal (20)	Khammam (21)	Karimnagar (22)	Adilabad (23)
I. 1.	3.63 (142.91)	2.52 (99.21)	2.94 (115.75)	2.79 (109.84)	3.75 (147.64)
2.	12.45 (45.92)	24.44 (90.15)	20.19 (74.47)	23.49 (86.65)	5.97 (22.02)
3.	0 .0009 (16.67)	0.0016 (29.63)	0.0020 (37.04)	0.0011 (20.37)	0.0002 (3.70)
4.	0.2764 (176.73)	0.0965 (61.70)	0.0390 (24.94)	0.1615 (103.26)	0.0203 (12.98)
5.	0.23 (58.97)	0.29 (74.36)	0. 3 (84.62)	0.21 (53.85)	0.28 (71.79)
6.	6.59 (58.D)	4,16 (37.11)	4.51 (40.23)	7.46 (66.55)	4.35 (7.91)
7.	5.04 (42.50)	6.09 (51.35)	2.37 (19.98)	6.03 (50.84)	3.41 (28.75)
TOTAL:	77.49	63.35	56.72	93.04	46,40
II.1.	17.45 (62.41)	25.02 (89.48)	20.15 (72.07)	25.31 (90.52)	5,88 (21.06)
2.					
3.	78.81 (84.22)	70.19 (75.01)	64.87 (69.32)	68.40 (73.09)	81.26 (86.83)
4.	21.00 (110.00)	16.23 (92.01)	80.05 (45.63)	16.17 (91.67)	24.04 (136.28)
5.	10.54 (84.66)	8.70 (69.88)	6.99 (56.14)	6.46 (51.89)	3.54 (28.43)
6.	5.09 (33.17)	3.93 (25.60)	8.09 (52.66)	14.43 (94.04)	2.97 (19.00)
TOTAL:	76.70	70.40	59.04	80.24	58.32
III.1.	228.57 (50.43)	196.18 (43.29)	369.10 (81.44)	200.28 (44.19)	204.60 (45.14)
2.	335.97 (72.08)	199.37 (42.88)	266.08 (57.08)	235.91 (48.47)	310.65 (66.64)
TOTAL	61.25	43.08	69.26	46.33	58.84

TABLE - 8

COMPARATIVE POSITION OF THE DISTRICTS IN ANDHRA PRADESH WITH REFERENCE TO SELECTED INDICATORS OF DEVELOPMENT 1974 - 75

Selected Indicators of Development.	Unit	A.P.	Srikakulam	Visakhapatnam.	East Godavari.	West Godavari.	Krishna	Guntur	Ongole	Nellore
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1. RESOURCE BASE & INFRASTRUCTURE.										
1. Cultivated land per Agricultural worker.	Acre	2.70 (100.0)	1.74 (100.0)	1.52 (64.44)	1.41 (56,29)	1.58 (52.22)	2.25 (58.51)	2.11 (83.33)	3.37 (78.14)	2.01 (124.81)
2. % of net area irrigated to net area sown.	%	29.10 (100.0)	45.2 (155.32)	39.1 (134.36)	62.4 (214.43)	74.9 (257.38)	61.3 (210.65)	48.5 (166.66)	23.7 (81.44)	62.7 (215.46)
3. Tractors per 100 acres of cultivated land.	Nos	0.021 (100.0)	0.005 (23.80)	0.006 (28.57)	0.082 (390.47)	0.068 (323.80)	0.070 (333.33)	0.048 (228.57)	0.015 (71.42)	0.079 (376.92)
4. Oil Engines and Electric motors per 100 acres of cultivated land.	"	0.07846 (100.0)	0.1475 (18.79)	0.2725 (34.73)	0.7978 (101.68)	0.0615 (135.29)	0.5561 (70.87)	0.2370 (30.20)	0.2469 (31.46)	1.6042 (204.46)
5. Road mileage per 1000 acres of cultivated land miles.	Miles	0.45 (100.0)	0.52 (115.55)	0.73 (162.22)	0.Ø82 (182.22)	0.70 (155.55)	0.50 (128.88)	0.58 (128.35)	0.43 (99.55)	0.71 (157.77)
6. % of members in Primary Agricultural credit & Multipurpose co-operatives to total Agriculture worker.	%	19.87 (100.0)	29.12 (146.55)	25.06 (126.11)	28.58 (143.83)	23.05 (116.00)	37.66 (189.53)	16.40 (82.53)	27.28 (137.29)	14.53 (73.12)
7. % Electrified villages & towns to total nos of towns and villages.		38.84 (100.00)	20.55 (52.90)	10.86 (27.96)	46.53 (119.79)	65.21 (167.89)	71.14 (183.16)	56.53 (145.54)	34.81 (89.62)	42.38 (109.11)
Total:-		100.00	82.47	81.46	172.09	173.48	171.39	122.93	90.22	172.93

TABLE (CONTD)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
II. INPUT USE										
1. % of gross area irrigated to gross cropped area	%	33.3 (100.00)	42.2 (126.17)	36.4 (109.30)	63.3 (190.09)	79.1 (237.53	54.9 (164.86)	50.6 (151.95)	26.2 (78.67)	64.5 (193.69)
2. % of area under HYV to gross cropped area.	%	16.63 (100.00)	11.56 (169.51)	21.16 (127.23)	42.66 (256.52)	52.69 (316.83)	24.94 149.56)	30.53 (183.58)	6.38 (38.38)	35.36 (212.62)
3. Intensity of cropping.	%	98.32 (100.00)	97.68 (99.34)	103.73 (105. 50)	132.08 (134.33)	122.39 (124.48)	131.35 (133.59)	130.02 (132.24)	91.49 (93.05)	101.70 (103.43)
4. % of area under commercial xx crops to total cropped area.	%	25.16 (100.00)	34.10 (135.53)	29.81 (118.48)	17.38 (69.08)	15.74 (62.55)	12.41 (49.32)	25.56 (101.58)	23.57 (93.68)	12.75 (50.67)
5. Nitrogeneous Fertilizer use per hectare cropped.	Kg.	71.54 (100.00)	63.27 (88.44)	48.32 (67.54)	76.12 (106.40)	206.74 (288.99)	70.93 (99.15)	182.25 (254.75)	56.35 (78.77)	94.53 (132.14)
6. Agricultural credit by Primary Ag. credit Multipurpose co-operatives per hectare cropped	Rs.	23.72 (100.00)	19.94 (84.06)	64.25 (270.83)	51.22 (215.93)	64.22 (270.72)	61.50 (259.27)	16.93 (71.35)	12.92 (54.47)	20.39 (85.93)
Total:-		100.00	100.51	133.15	162.06	216.85	142.63	149.24	72.84	129.75
III PRODUCTIVITY										
1. Value of Agriculture produce per hectare cultivgted	Rs.	716.23 (100.00)	680.40 (94.99)	627.77 (87.64)	1580.88 (220.72)	1856.70 (259.23)	1302.66 (181.87)	1195.64 (166.93)	613.66 (85.67)	861.98 (120.34)
2. Value of Agrl. produce per Agrl. Worker.	Rs.	783.29 (100.00)	479.13 (61.16)	386.07 (49.28)	901.52 (115.09)	1183.44 (151.08)	1187.08 (151.55)	1018,76 (130.66)	837.59 (106.93)	702.04 (89.628
Total:-		100.00	78.07	68.46	167.90	205.15	166.71	148.79	96.30	104.98

TABLE - 7

RANK CORRELATIONS

	Items	1960-61	1974-75
1.	Output and Input index	0.8767	0.8588
2.	Output and Index of Resource base and infrastructure	0.8526	0.8134
3.	Index of Input and Index of Resource base and infrastructure.	0.8767	0.7707
4.	Increase in Output and Input index in 1974-75	--	0.5429
5.	Increase in Output and Index of resource base and infrastructure in 1974-75	--	0.8195

TABLE - 8

CROPPING PATTERN IN THE DISTRICTS OF ANDHRA PRADESH IN 1960-61 & 1974-75

District	Rice		Jowar		Total Cereals & Millets		Total Food Crops		Groundnut		Castor		Cotton		Total non-food crops.	
	1960-61	1974-75	1960-61	1974-75	1960-61	1974-75	1960-61	1974-75	1960-61	1974-75	1960-61	1974-75	1960-61	1974-75	1960-61	1974-75
Srikakulam	51.3	41.1	1.1	1.0	66.2	53.4	83.2	68.2	5.9	15.3	0.7	-	-	-	16.8	31.8
Visakhapatnam.	34.9	27.3	3.0	3.6	66.1	54.1	81.2	75.7	8.6	13.1	-	0.1	-	-	18.8	24.3
East Godavari	60.6	58.1	3.1	2.5	69.8	65.3	86.9	85.9	1.1	2.5	-	-	0.1	0.2	13.1	14.1
West -do-	72.1	67.9	3.1	1.7	76.4	71.1	89.6	90.6	1.5	2.1	0.1	0.1	-	0.2	10.4	9.4
Krishna	59.8	50.1	15.2	9.9	75.6	61.6	91.4	88.2	2.7	5.1	-	0.2	-	0.7	8.6	11.8
Guntur	22.5	43.6	19.7	5.8	64.3	58.3	79.9	77.1	3.4	4.6	0.6	2.2	0.6	8.6	20.1	22.9
Prakasam	-	13.3	-	21.4	-	65.3	-	73.8	-	2.9	-	3.6	-	6.0	-	26.2
Nellor	31.0	49.5	26.0	16.2	81.9	76.9	91.0	85.8	1.4	6.7	2.7	0.2	0.6	0.6	9.0	14.2
Coastal Andhra	44.3	43.5	12.3	7.9	71.0	62.6	85.9	80.5	3.3	6.1	0.7	1.0	0,3	2.6	14.1	19.5
Kurnool	4.8	8.3	28.5	28.6	62.3	56.3	69.8	63.8	13.9	19.1	0.7	0.2	14.0	13.4	30.2	36.2
Anantapur	5.2	9.9	20.4	15.1	58.8	48.4	72.1	64.2	19.4	30.3	1.0	0.8	5.5	2.1	27.9	35.8
Cuddapah	14.1	17.2	30.1	22.2	71.7	59.9	82.0	71.2	13.7	25.3	0.1	0.2	2.9	1.6	18.0	28.8
Chittoor	26.7	24.8	5.2	2.1	62.3	41.2	75.1	53.3	23.0	45.1	0.1	0.1	-	-	24.9	46-7
Rayalaseema	9.6	13.1	22.5	18.6	62.5	51.6	73.1	63.1	17.7	28.3	0.6	0.3	7.4	5.7	26.9	36.9
Hyderabad	14.5	11.2	30.3	30.9	57.5	56.9	80.8	77.9	1.1	2.4	9.7	11.3	-	0.1	19.2	22.1
Nizamabad	37.0	37.6	22.0	15.5	69.1	68.5	91.2	92.8	2.0	3.5	0.1	0.5	1.6	0.9	8.8	7.2
Medak	18.9	22.0	30.7	31.2	64.1	69.4	89.8	91.0	0.7	1.0	1.8	2.7	0.1	0.2	10.2	9.0
Mohaboobnagar.	10.6	11.7	35.2	32.3	68.6	61.7	82.9	75.1	4.7	10.3	8.8	12.0	0.7	0.7	17.1	24.9
Nalgonda	16.9	28.5	32.8	20.1	67.1	64.9	79.3	73.3	4.7	6.6	14.8	19.2	0.1	0.2	20.7	26.7
Waragal	22.2	18.9	39.4	31.4	73.0	63.8	92.6	66.2	2.1	7.1	1.8	3.6	0.1	0,3	7.4	13.8
Khammam	24.1	18.1	64.2	42.2	74.2	65.2	90.7	86.7	1.6	7.3	0.4	0.2	-	0.3	9.3	13.3
Karimnagar	21.1	25.3	26.9	21.3	61.6	63.6	85.0	88.3	2.0	5.5	1.3	1.9	0.2	0.2	15.0	11.7
Adilabad	10.9	9.2	40.5	39.1	56.1	52.8	77.7	73.5	0.6	2.1	0.8	0.6	10.2	15.1	22.3	26.5
Telangana	18.0	19.6	33.9	29.4	65.9	62.8	84.6	81.1	2.8	5.7	5.6	7.2	1.4	2.1	15.4	18.9

TABLE - 8(Contd)

Khammam	24.1	18.1	64.2	42.2	74.2	65.2	90.7	86.7	1.6	7.3	0.4	0.2	-	0.3	9.3	13.3
Karimnagar	21.9	25.3	26.9	21.3	61.6	63.6	85.0	88.3	2.0	5.5	1.3	1.9	0.2	0.2	15.0	11.7
Adilabad	10.9	9.2	40.5	39.1	56.1	52.8	77.7	73.5	0.6	2.1	0.8	0.6	10.2	15.1	22.3	26.5
Telangana	18.0	19.6	33.9	29.4	65.9	62.8	84.6	81.1	2.8	5.7	5.6	7.2	1.4	2.1	15.4	18.9
Andhra Pradesh	25.1	26.7	23.1	19.1	66.7	60.1	81.9	76.7	6.8	11.1	2.6	3.3	2.6	3.1	18.1	23.3
Yield per hectare (in Kgs.).	1238.		1604		497		619									

*Bales of 180 Kgs. lint.

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GROWTH RATES IN AGRICULTURE IN RAJASTHAN AND WESTERN RAJASTHAN : AN ANALYSIS

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GROWTH RATES IN AGRICULTURE IN RAJASTHAN AND WESTERN RAJASTHAN : AN ANALYSIS

A.C.Angrish* & K.P.Khokhal**

In this paper an attempt has been made to study the growth rates in agriculture in Rajasthan as a whole as well as arid area of Western Rajasthan. The study was confined to take into account the following distribution of crops and / or group of crops :

1. Food grains : Jowar, Wheat, Barley, Gram
2. Pulses
3. Non-Food Grains
4. All crops (1 to 3)

The above crops were taken for study since they command larger proportion of area under cultivation and possess the attribute of comparative advantage in respect of climate, topography, soil and economic considerations which have been favourable in providing increased production and productivity vis-a-vis the other crops in the State. It was, therefore, presumed that these crops possess greater potentiality for better cultivation and specialization in this area.

We have calculated the indices of area, production and productivity for principla crops and group of crops for the state of Rajasthan, as a whole, and Western Rajasthan for the period 1961-62 to 1971-72. For working out the index numbers for agricultural production the weights assigned in the Government of India, Publication on "Growth Rates in Agriculture" [1] were taken.

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1. Directorate of Economics and Statistics, Ministry of Food , Agriculture, C.D. and Cooperation, Growth Rates in Agriculture, New Delhi, 1964, p. 23.

There are several methods of computation of growth rates and several studies have been done so far.[2]

Since the aim of this study is to estimate the trend during the specified period of time for purposes of inter-crop comparisions, the use of the 'Linear' trend for estimation of the growth rates has been made. The 'Linear' trend shows a constant amount of increase or decrease per unit of time.

Rajasthan State and Western Rajasthan Growth Rates: 1960-61 to 1972-73

For this period, growth rates of area under crops, agricultural production and productivity have been computed for the Rajasthan as a whole and Western Rajasthan separately. The index numbers of three yearly moving averages were first calculated. These indices were further adjusted by taking the average of indices for the first triennium, i.e. 1965-66 to 1967-68, as 100. By taking time as the independent variable and the adjusted index number of the moving averages as the independent variable, a linear equation, i.e. $y = a + bx$ was fitted. In this equation y denotes the adjusted index numbers of three yearly moving averages and X denotes time. The value of 'b' in the linear equation represents the slope of the time and gives an estimate of linear growth rate per annum.[3] The mathematical formula for 'b' is given below :

$$b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$

Where $\bar{x}$ and $\bar{y}$ are the averages of X and y and n is the number of pairs of observations.

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2. See ChhRao , Growth of Agriculture in the Punjab during the decade 1952-62, IJAE, XX(165) 3,pp.20-34, Gopinath and others, Growth Trends in Area, Production and Productivity and F.C.V.; Tobacco in A.P., JAE XXVII(1972) 2,pp.67-69; A.S.Kahlon, Johl and Singh: Agricultural growth rates in the Punjab, Mimeograph 1968; Minhas B.S. and Vidyanathan, A Growth of crop out-put in India- An analysis by component elements, J.Indian Sec. Agriculture and Statistics.

3. Snedecor, G.W. and Cocharan, W.G. : Statistical Methods (Calcutta, Oxford & IBM Publishing Co.1967 ,pp.447-452

Linear growth rate for a particular crop or a group of crops depends upon the level of area under crops, agricultural production, and productivity in the base period. To give an idea of the effect of the base on the growth rates of different crops, attempt is being made to present growth rates along with standard errors for area under important crops, agricultural production and productivity of important crops during 1960-61 to 1972-73 with 1965-66 to 1967-68 as the base years. This has been explained in the text.

Standard Errors of Growth Rates:

Standard errors of growth rates have been calculated so as to have an idea of the precision of various growth rates. The mathematical formula for standard error of 'b' is given below[4] :

$$Sb = \sqrt{\frac{\sum(y-\bar{y})^2 - \left[\frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(x-\bar{x})}\right]^2}{(n-2)\quad \sum(x-\bar{x})^2}}$$

Standard errors of the state of Rajasthan and Western Rajasthan and the linear growth rates of area under crops, agricultural production and productivity for different crops along with growth rates for the period 1961-62 to 1971-72 is thus worked out .

Goodness of Fit :

The linear trends fitted, have been tested for goodness of fit. For this purpose, the technique of analysis of variance has been made use of. This test has shown that in amny cases linear trends fitted well.

In the light of the above, the present work has, therefore, adopted the linear equation approach for all the three series, viz. area, production and productivity.

In this study only the relative contribution of area and productivity to the growth of production has been studies.

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4. Ibid.,pp.447-452.

Besides area and productivity, changes in the cropping pattern, use of fertilizers, insecticides, availability of irrigation etc. have an important bearing on the growth rates of production. It is obvious that the growth rates of agricultural production as worked out here should reflect the contribution of all the component elements, not excluding the cropping patterns. The relative contribution of these factors would, it is obvious, vary with the period of study.

RESULTS AND DISCUSSION

I

Rajasthan State as a whole

Table I reveals that for all crops in Rajasthan, the linear rate of growth of production during the eleven year period under study was 4.33 percent per annum and was highly significant at 1 percent level. To this rate of growth, productivity rose at the linear rate of 3.25 per cent per annum and was significant at 5 percent level. It contributed more than area which had a highly significant rate of growth . The growth rate of production of food grains was much higher and highly significant than that of pulses and non-food grains. The same holds true with regard to the rates of growth of productivity of foodgrains. In pulses, the rate of growth of productivity was lower than that of production, while the rate of growth of area was positive and highly significant at 1 percent level.

TABLE I

RAJASTHAN STATE LINEAR GROWTH RATES DURING 1961-62 to 1971-72
(Average 1965-66 to 1967-68 = 100)

Group of Crops	Agricultural Production (Percent)	S.E.	Area under Crops (Percent)	S.E.	Agricultural Productivity (Percent)	S.E.
1.Food grains	4.33**	1.22	0.74*	0.29	3.97**	0.80
2.Pulses	1.34	1.34	1.70**	0.40	-0.62	1.72
3.Nonfood-grains	1.38	1.40	-1.29	1.14	3.46	1.57
4.All crops	4.33**	1.23	0.82**	0.21	3.25*	1.09

* Significant at 5 per cent level ** Significant at 1 per cent level

Note :Figures with no stars indicate non-significant.

The higher rates of growth of production in the case of food grains and all crops was perhaps due to the increase in area than productivity. In the case of non-foodgrains on the other hand productivity rose much faster than area. The growth rate of area of nonfoodgrains was negative and the growth rate of productivity of pulses was also negative. For all crops the growth rate of production was higher and highly significant than that of productivity. There has, however, been relatively greater improvement in productivity during the later years of study and this trend need to be accelerated to achieve higher growth rates of foodgrains production in the years to come.

The S.E. of all crops for production, area and productivity, does reveal fluctuations but relatively less than Pulses and nonfoodgrains. The variations in productivity in foodgrains and pulses are the least and the highest respectively.

Cropwise Growth Rate

The above discussion relates to the growth rates of Rajasthan State with regard to all crops taken together and the three major groups viz. foodgrains, pulses and non-foodgrains. It would be interesting to study the behaviour of some important individual crops. Table II shows the growth rates of area, production and productivity under crops in the State of Rajasthan.

It will be seen that there are considerable variations in the magnitudes of increase in the production of different crops and the relative contribution of area and productivity to such increases. These variations stem mainly from the differences in the physical and climatic conditions under which the different crops are growth. The growth rates of production of Bajra, and Wheat were higher and highly significant but show higher variations than the growth rate of other food crops and the growth was quite lower in production in case of Jowar, though it shows significance at 5 percent level and less fluctuations as is clear from its S.E. There were marked differences in the pattern of relative contribution of area and productivity to the increase in production of different crops. In the case of wheat, which is the most extensively cultivated crop in Rajasthan State and is generally grown in areas having assured rainfall or controlled irrigation, use of chemical fertilizers has increased the growth ratesof productions and productivity of the crop.

TABLE II

GROWTH RATES OF IMPORTANT CROPS OF RAJASTHAN STATE DURING 1961-62 to 1971-72

(Average 1965-66 to 1967-68 = 100)

Crop Group	Agricultural production (percent)	S.E.	Area under crops (Percent)	S.E.	Agricultural productivity (Percent)	S.E.
Bajra	5.08**	1.36	1.20**	0.36	3.34	1.61
Jowar	1.37**	0.61	-0.90**	0.17	1.94**	0.50
Wheat	7.64**	1.94	2.28*	1.01	4.05**	0.83
Barley	1.92	0.95	0.61	0.82	1.48**	0.42
Gram	2.75	1.96	-0.94	1.29	3.08	1.16

* Significant at 5 per cent level
**Significant at 1 per cent level

NOTE : Figures with no star indicate non-significance.

The linear growth rate of production of wheat was highest while Bajra, had proved to be the second most important cereal crop. In this case however, the rate of growth of area was much lower than that of productivity though it was highly significant. The increase was achieved because of the use of high yielding varieties, and chemical fertilizers in the state. The variations as revealed by S.E. in case of wheat was significant as compared to Bajra. The growth rates of productivity of Jowar and Barley crops where highly significant at 1 percent level though the growth rate of production of Jowar alone was highly significant at 1 percent level. But there seemed to be a fall in the area under Jowar during the period under study.

II

Western Rajasthan

Table 3 shows that in Western Rajasthan for all crops, the linear rate of growth of production during eleven year period under study was negative. It was -3.26 per cent per annum and highly significant at 1 % level. For productivity, the growth rate was significantly negative at 1 per cent level of significance. Thus, both production and productivity declined significantly for all crops. In case of food grains, the rates of growth of production, area and productivity also show highly significant negative growth at 1 per cent level of significance. This shows a fall in production and productivity. The variations in area were the least since its S.E. is 0.23. The rate of growth of production, area and productivity for nonfoodgrains was relatively higher than foodgrains and pulses though the fluctuations were the maxium in non foodgrains.

In case of pulses, the rate of growth of productivity was negative while the rate of growth of production was higher than productiivity and also relatively higher than all crops and foodgrains.

TABLE III

WESTERN RAJASTHAN LINEAR GROWTH RATES FOR GROUP OF CROPS DURING 1961-62 to 1971-72

(Average 1965-66 to 1967-68 = 100).

Group of crops	Agricultural production (Percent)	S.E.	Area under crops (percent)	S.E.	Agricultural productivity (Percent)	S.E.
Foodgrains	- 4.15**	0.88	-0.90**	0.23	-3.12**	0.72
Pulses	0.31	0.64	0.745	0.51	-0.64	1.022
Nonfood grains	1.65	2.76	-2.05	1.23	2.45	2.24
All crops	-3.26**	0.76	-0.59	0.45	-2.79**	0.57

** Significant at 1 per cent level

NOTE : FIgures with no stars indicate non significance.

In nonfoodgrains the rate of productivity was higher than production and area because of factors like irrigation, fertilizer etc.

The rate of growth, of area, production and productivity of all crops and food grains was generally higher in the earlier years of the study as against the later year.

Cropwise Growth Rate

It will be observed from Table IV that there are wide variations in the magnitude of production of different crops and the relative contributions of area and productiivity to these crops.

TABLE IV

WESTERN RAJASTHAN LINEAR GROWTH RATES OF IMPORTANT CROPS AND GROUPS OF CROPS During 1961-72 to 1971-72

(Average 1965-66 to 1967-68 = 100)

Group of Crops	Agricultural Production (Percent)	S.E.	Area under crops (Percent)	S.E.	Agricultural productivity (Percent)	S.E.
Bajra	-2.71	1.37	1.42*	0.46	-3.54**	0.9[illegible]
Jowar	4.16	10.82	-9.35**	2.36	11.06	5.80
Wheat	-2.44	1.59	-6.05**	1.15	2.73**	0.60
Barley	-2.56*	0.94	-7.26**	1.81	2.95	1.08
Gram	-22.93**	2.91	-3.19	4.99	0.60*	2.19

* Significant at 5 per cent level

**Significant at 1 per cent level

NOTE : Figures with no star indifate non-significance.

The growth rate of production and productivity of Jowar was highest than other crops and at the same time its fluctuations were highest. The growth rates of area off Jowar was lower as compared to production and productivity

and it shows a significant negative tendency at 1 per cent level which indicates a significant fall in acreage under this crop during the period under study.

In case of Bajra, the growth rate of area was significant at 5 per cent level but the rate of production and productivity of Bajra reveals a negative tendency. The productivity was significantly negative at 1 per cent level which showed a significant decline in the yield of this crop.

In wheat the rate of growth of productivity which was 2.73 per cent and significant at 1 per cent level depicted lesser degree of fluctuations. It was positive as compared to the rate of growth of production and area. This reflects an increase in the yield of wheat in Western Rajasthan which might be because of intensive cultivation of this crop. The rate of growth of area and production of wheat was however negative. The area was significantly negative at 1 per cent level significance which indicates a significant fall in acreage of this crop.

In the case of gram the rate of productivity y was higher than production and area. The rate of growth of area and production was however negative. Agricultural production was significantly negative at 1 per cent level of significance. This shows that the production of this crop experienced a severe decline and with it the acreage also fell during this period.

The growth rate of productivity of barley was 2.95 and was significant at 5 per cent level, though there was a fall in production and acreage during this period.

III

Relative Comparision of linear growth rates of Rajasthan State and Western Rajasthan during 1961-62 to 1971-72 for group of crops

Linear growth rates of agricultural production, area under crops and agricultural productivity for three major groups of crops for the period 1961-62 to 1971-72 were worked out. They have been presented in Table V for comparing the relative increase or decrease in growth rates for these groups. It can be observed from Table V that in case of food grains, there was a considerable increase and high significance in production, area and productiivity in Rajasthan as a whole as compared to Western Rajasthan where the growth rate of production, area and productivity of foodgrains was however, negatively significant. Foodgrains production and productivity showed higher variations in Rajasthan as a whole than Western Rajasthan. Thus, we find that Western Rajasthan experienced a significant fall in production and productivity so far as foodgrains are concerned and along with it the acreage falling under foodgrains also showed a significant fall.

If we compare Rajasthan state as a whole with Western Rajasthan, so far as pulses are concerned, we find that the growth rate of production and area was positive in both the cases. But the rate of growth of productivity was negative in both the regions though the fall of productivity was of the same magnitude. Area under pulses crops in Rajasthan showed high significance at 1 percent level, which reflects an increase in acreage in Rajasthan as a whole as compared to Western Rajasthan.

The rate of growth in productivity of non-foodgrains in Rajasthan state as a whole which was 3.46 was higher than Western Rajasthan, where it was 2.45 but in the case of production, the growth rate was lower than Western Rajasthan. This means that though the yield of non-foodgrains has been low in Western Rajasthan but the rate of production is relatively high as compared to

Rajasthan as a whole. But the variations in production have been relatively more as compared to Rajasthan as a whole. The growth rate of area of Rajasthan State and Western Rajasthan was however, negative which indicates a fall in acreage. With regard to all crops, the growth rates of production, area and productivity of Rajasthan State was much higher and positive and highly significant at 1 per cent level, than what we notice in Western Rajasthan. The rates of growth with regard to production and productivity for all crops in Western Rajasthan were significantly negative which shows the fall in both. The production and productivity in Rajasthan State as a whole however, showed relatively more variations as compared to Western Rajasthan.

In Rajasthan State as a whole, the rate of growth of individual crops reflected a good performance. For Bajra, the rate of growth of production in the State of Rajasthan was 5.08 which was highly significant at 1 per cent level while it was negative in Western Rajasthan. But the rate of growth of area of Bajra in case of Western Rajasthan was positive and significant at 5 per cent level and higher than Rajasthan. This shows that the acreage under this crop increased in Western Rajasthan during this period, this being the staple food of the people. The rate of productivity of Bajra in Rajasthan state as a whole was however, higher showing little variations as compared to Western Rajasthan.

In the case of Jowar, the growth rates of production and productivity in Rajasthan state as a whole was significant at 5 percent and 1 per cent level respectively, while they were non-significant in Western Rajasthan. The acreage under this crop fell sharply in Western Rajasthan as compared to Rajasthan as a whole.

TABLE V

RAJASTHAN STATE AND WESTERN RAJASTHAN LINEAR GROWTH RATES OF GROUP OF CROPS DURING 1961-62 to 1971-72

(Average 1965-66 to 1967-68 = 100)

Group of Crops	Agricultural Production (Percent)				Area Under Crops (Percent)				Agricultural Productivity (Percent)			
	Rajas-than	S.E.	Wes-tern Rajas-than	S.E.	Rajas-than	S.E.	Wes-tern Rajas-than	S.E.	Rajas-than	S.E.	Wes-tern Rajas-than	S.E.
Foodgrains	4.53**	1.22	-4.15**	0.88	0.74**	0.29	-0.90**	0.23	3.79**	0.80	-3.12**	0.72
Pulses	1.34	1.34	0.31	0.64	1.70**	0.40	0.745	0.51	-0.62	1.73	-0.64	1.02
Nonfood-grains	1.38	1.40	1.64	2.76	-1.29	1.24	-2.05	1.23	3.46	1.57	2.45	2.24
All Crops	4.33**	1.13	-3.26**	0.76	0.82**	0.21	-0.59	0.45	3.25*	1.09	-2.79**	0.57

* Significant at 5 per cent level
** Significant at 1 per cent level

NOTE : Figures with no stars indicate the non-significance

For wheat, the growth rate of production, area and productivity of the state as a whole was higher than Western Rajasthan and highly significant at 1 per cent level while in Western Rajasthan, there has been a decline in production and fall in acreage though yield seemed to have imcreased significantly at 1 per cent level.

In the case of Barley crop, the rate of growth of production and area for the state of Rajasthan was higher than Western Rajasthan but the rate of growth of productivity in Western Rajasthan was higher and significant at 5 per cent level showing larger variations as compared to the state as a whole.

The rate of growth of productivity of gram in the state as a whole was significant at 5 per cent level, which reflects a higher yield as compared to Western Rajasthan. There has been a fall in acreage and production for this crop in Western Rajasthan during this period. The production of this crop was the lowest than all individual crops of Western Rajasthan.

This analysis supports the established belief that Western Rajasthan with arid area is less progressive as compared to the state as a whole. With vast differences in soil, climate, irrigation facilities and use of fertilizers etc. in between the state as a whole and Western Rajasthan, the progress of agricultural production would naturally not be uniform between the two. In areas having assured rainfall and potentialities for controlled irrigation, speedy progress is possible. On the other hand, in areas where rainfall is low and scanty and irrigation facilities are available only to a small proportion of the cultivated area, the rate of progress in agricultural production is bound to be at a lower rate. Obviously, in such areas agricultural production would take longer to get stablised around higher levels.

In the state of Rajasthan, the rate of growth of individual crops reflects a good performance. It moves at an increasing rate but the situation is not so encouraging in the case of Western Rajasthan.

TABLE VI

RAJASTHAN STATE AND WESTERN RAJASTHAN LINEAR GROWTH RATES OF IMPORTANT CROPS DURING 1961-62 to 1971-72

(Average 1965-66 to 1967-68 = 100)

Group of Crops	Agricultural Production (Percent)				Area Under Crops (Percent)				Agricultual Productivity (Percent)			
	Rajas-than	S.E.	Wes-tern Rajas-than	S.E.	Rajas-than	S.E.	Wes-tern Rajas-than	S.E.	Rajas-than	S.E.	Wes-tern Rajas-than	S.E.
Bajra	5.08**	1.36	-2.71	1.37	1.20**	0.36	1.42*	0.46	3.34	1.61	-3.54**	0.96
Jowar	1.37*	0.61	4.16	10.82	-0.90**	0.17	-9.35**	2.36	1.94**	0.50	11.06	5.80
Wheat	7.64**	1.94	-2.44	1.59	2.28**	1.01	-6.05**	1.15	4.05**	0.83	2.73**	0.69
Barley	1.92	0.95	-2.56*	0.94	0.61	0.82	-7.26**	1.81	1.48**	0.42	2.95*	1.08
Gram	2.75	1.96	-22.93**	2.91	-0.94	1.22	-3.19	4.99	3.08*	1.16	0.609	2.19

* Significant at 5 per cent level

** Significant at 1 per cent level

NOTE : Figures with no star indicate the non-significance.

Districtwise growth Rates : 1969-70 to 1973-74 : Cropwise :

The preceeding discussion about Western Rajasthan will find support if we analyse the cropwise growth rates of the district of Western Rajasthan.

The linear growth rates of area under important crops, agricultural production and productivity of different districts in Western Rajasthan along with their S.E. during 1969-70 to 1973-74 are being presented in the Appendix.

A cropwise estimate with regard to different districts is discussed below :

BAJRA CROP

The rate of growth of area of Bajra crop was positive and highly significant at 1 per cent level in the district of Barmer and was significant at 5 percent level in Pali district. The variations as revealed by S.E. were higher in Barmer district as compared to Pali district. The growth rate of area was however, positive but not significant in districts of Churu, Jaiore, Jodhpur, Magour and Sikar. There was a significant fall in acreage of this crop in the districts of Jaibalmer and a general fall in the districts of Bikaner, Jhunjhunu and Sirohi.

The rate of growth of production of this crop was unfortunately not significant with positive rate of growth in any of the districts of Western Rajasthan which clearly shows the stagnant situation of production of Bajra crop. However, in districts like Barmer, Bikaner, Jalore, Jodhpur, Pali and Sirohi though the rate of growth was positive but it was non-significant, Almost all these districts showed wider fluctuations, the maxium was in Barmer district and minimum was in Bikaner district. The decline in production was significant in the districts of Sikar and Jhunjhunu while some districts like Churu, Jaisalmer and Nagour also experienced a fall in production.

The rate of growth of productivity of Bajra crop was positive and non-significant in districts of Jalore, Jodhpur, Pali and Sirohi and the variations were maximum in Pali and minimum in Sirohi. In the rest of the districts there was a decline in productivity. In the district of Sikar the rate of growth was negatively significant at 1 per cent level.

JOWAR :

The rate of growth of area of Jowar was positive and significant at 5 percent level in the districts of Bikaner and Nagour. In the rest of the districts the rate of growth was negative and non-significant which means that there was a decline in acreage in those districts.

The rate of growth of production of this crop was positive and non-significant in the districts of Barmer, Bikaner, Jaisalmer and Jhunjhunu. It showed wider fluctuations in all these districts, maximum being in Jaisalmer district and minimum in Barmer district. In districts like Jalore there was a significant decline in production while other districts like Churu, Jodhpur, Nagour, Pali and Sirohi also experienced a fall.

The rate of growth of productivity of Jowar crop was positive and non-significant in the districts of Churu and Jodhpur, the variations being high in Churu district. In rest of the districts the rate of growth of productivity was negative, which indicates a fall in yield of this crop.

WHEAT :

The rate of growth of area with regard to wheat crop was positive and highly significant at 1 percent level in Jhunjhunu, Nagour, Pali and Sikar districts. In the rest of the districts though the rate of growth of area of this crop was positive but was non-significant. Jaisalmer is the only district which showed a fall in acreage of wheat.

The rate of growth of production of wheat was positive and significant at 5 percent level in the districts of Jaisalmer and Pali and the fluctuations being high in Jaisalmer as compared to Pali. There was a fall in production in the districts of Jalore, Jhunjhunu, Jodhpur, Nagour, Sikar and Sirohi during this period.

The rate of growth of productivity of this crop was positive and significant at 5 percent level in Nagour district alone. In Jhunjhunu, it was positive but not significant while in rest of the districts it was negative. The fall in yield and production of this crop indicates the non-significance of thiss crop in Western Rajasthan as a whole.

BARLEY :

The rate of growth of area of Barley was positive and significant at 5 percent level , in Jhunjhunu district alone while it was positive and non-significant in Bikaner, Nagour and Pali districts. There was a significant fall in acreage in Jaisalmer, Jhunkhunu, Sikar and Sirohi districts.

The rate of growth of production of this crop was positive and non-significant in Bikaner, Jhunjhunu, Jodhpur and Pali district. There was a significant fall in production in the districts of Churu and Sikar while in majority of the districts the production experienced a fall.

The rate of growth of productivity of this crop was positive and non-significant in the districts of Jhunjhunu, Jodhpur and Nagour, the variations being highest in Jodhpur district and minimum in Nagour district. There was a significant fall in productivity in the districts of Churu and Sikar. In other districts like Barmer, Bikaner, Jaisalmer, Jalore, Pali and Sirohi there was a tendency for yield to fall also during this period.

GRAM :

The rate of growth of area of Gram was positive and highly significant at 1 per cent level in the districts of Bikaner and Jaisalmer and significant at 5 percent level in the districts of Churu and Jodhpur. A fall in acreage of this crop was there in the districts of Barmer, Pali and Sirohi.

The rate of growth of production of this crop was positive and significant at 5 percent level in the districts of Bikaner, Jaisalmer, Jodhpur and Sirohi, the maximum variations being in the Bikaner district and minimum in Jodhpur district. There was a significant fall in production in the districts of Jhunjhunu and Churu.

The rate of growth of productivity of this crop was positive but non-significant in the districts of Bikaner and Sikar while in the rest of the district, it was negative.

PULSES

With regard to this crop, the rates of growth of area of almost all districts were positive excepting three districts Bikaner, Churu and Jhunjhunu. They were highly significant at 1 percent level in the districts of Jalore, Nagour and Sirohi and significant at 5 percent level in Jaisalmer district only. The fall in acreage was highest in Jhunjhunu followed by Churu and Bikaner districts.

The rate of growth of production was positive and highly significant at 1 percent level in Jalore district alone while other districts like Bikaner though show positive growth rate but indicate no significance. Some of the districts like Nagour, Sikar and Sirohi show high significance negatively which reflects the fall in production in these districts.

The rate of growth of productivity was positive and highly significant at 1 percent level in Bikaner district alone, though it showed wider fluctuations. The rate of growth was positive and non-significant in districts like Bikaner, Churu, Jaisalmer, Jalore, Jodhpur and Pali while in the rest of the districts productivity growth rate was negative.

TOTAL FOODGRAINS

The rate of growth of area of total foodgrains in different districts of Western Rajasthan show that it was positive and highly significant at 1 percent level in the districts of Barmer, and Sikar and significant at 5 percent level in the districts of Bikaner and Jodhpur only. There was a significant decline in acreage in the district of Jaisalmer.

The rate of growth of production was positive but non-significant in the district of Churu, Jalore and Jodhpur, the maximum fluctuations being in Jodhpur district and minimum in Churu district. The districts of Bikaner and Sikar experienced a significant fall in production.

The rate of growth of productivity was positive and significant at 5 percent level in the district of Churu alone while it was positive and non-significant in the district of Jalore, Jodhpur and Pali. A significant fall in productivity was noticeable in the districts of Bikaner and Sikar during this period.

NON FOODGRAINS

The growth rate of area with regard to non-foodgrains was positive and highly significant at 1 percent level in the district of Jalore and was positive and significant at 5 percent level in the district of Pali. There was a negative significant growth rate in the district of Churu and Sikar.

The rate of growth of production of non-foodgrains was positive and highly significant at 1 percent level in the districts of Nagour alone, while it was positive but non-significant in the districts of Barmer, Bikaner, Jaisalmer, Jodhpur , Pali and Sirohi. There was a significant fall in production in the districts of Churu followed by the district of Jhunjhunu.

The rate of growth of productivity of non-foodgrains was positive and significant at 5 percent level in the districts of Jaisalmer and highly significant at 1 percent level in Nagour district. The districts of Churu, shows a significant fall in productivity, though other districts like Barmar, Bikaner , Jalore , Jodhpur and Sikar also experienced a fall.

ALL CROPS

The rate of growth of area of all crops was positive and highly significant at 1 percent level in the districts of Barmer, Jalore, Jodhpur and was positive and significant at 5 per cent level in the district of Pali. There was a significant fall in acreage in the districts of Jalore and Jaisalmer during this period though this trend is noticeable in the case of other districts like Churu, Jhunjhunu and Sikar during this period.

The rate of growth of production of all crops was positive and non-significant in the districts of Barmer, Jalore, Jodhpur and Pali and the variations were maximum and minimum in Jalore and Barmer districts respectively. The fall in the production is noticeable in the districts of Bikaner, Nagour and Sikar.

The rate of growth of productivity of all crops was positive and non-significant in the districts of Churu, Jalore and Jodhpur. The rate of growth was negative in rest of the districts which indicates the fall in productivity.

CONCLUSION

Thus we find that Western Rajasthan taken together and if disaggregated into districts, reveals its backwardness vis-a-vis the state as a whole, though the latter itself does not show much progress by way of production and productivity. Production and productivity is a strong constraint for the planned agricultural development of this region. The situation of Western Rajasthan particularly needs careful attention for bringing about agricultural development as there is the potential to be exploited so as to increase production and productivity which may develop towards the desired pattern of rate of agricultural growth which may ultimately be helpful in reducing regional desparities of this region.

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R.K.S.

STATEMENT SHOWING THE PERCENTAGE OF THE GROWTH RATE AND STANDARD ERROR OF THE GROWTH RATE DURING 11 YEARS FROM 1961-62 to 1971-72

RAJASTHAN AS A WHOLE AND WESTERN RAJASTHAN

	BAJRA			JOWAR			WHEAT			BARLEY		
I.	A 2.	P 3.	Pr 4.	A 5.	P 6.	Pr 7.	A 8.	P 9.	Pr 10.	A 11.	P 12.	Pr. 13.
RAJASTHAN AS A WHOLE												
"b"	1.20	5.08	3.34	-0.9	1.37	1.94	2.28	7.64	4.05	0.61	1.92	1.48
"Sb"	0.36	1.36	1.61	0.171	0.61	0.5	1.01	1.94	0.825	0.815	0.954	0.415
"t"	3.33	3.724	2.07	-5.26	2.25	3.88	2.26	3.94	4.91	0.75	2.01	3.57
	**	**	N.S.	**	*	**	*	**	**	N.S.	N.S.	**
WESTERN RAJASTHAN												
"b"	1.42	-2.71	-3.54	-9.35	4.16	11.06	-6.05	-2.44	2.73	-7.26	-2.56	2.95
"Sb"	0.46	1.37	0.955	2.36	10.815	5.80	1.15	1.59	0.597	1.81	0.94	1.08
"t"	3.09	-1.99	-3.71	-3.96	0.385	1.91	-5.26	-1.53	4.57	-4.01	-2.72	2.73
	*	N.S.	**	**	N.A.	N.S.	**	N.S.	**	**	*	*

-Contd...

Statement showing the percentage of the growth rate and standard error of the growth rate during 11 years from 1961-62 to 1971-72 Rajasthan as a whole and Western Rajasthan(Contd.)

	GRAM			TOTAL FOODGRAINS			PULSES			NON FOODGRAINS			TOTAL		
	A	P	Pr.	A	P	Pr.	A	P	Pr.	A	P	Pr.	A	P	Pr.
1.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.
RAJASTHAN AS A WHOLE															
"b"	-0.94	2.75	3.08	0.74	4.53	3.79	1.70	1.34	-0.62	-1.29	1.38	3.46	0.82	4.53	3.25
"Sb"	1.285		1.155	0.29	1.22	0.80	3.369	1.34	1.73	1.135	1.40	1.57	0.208	1.23	1.09
"t"	-0.73	1.96 1.40	2.67	2.55	3.71	-4.74	4.61	1.00	-0.036	-1.14	0.99	2.21	3.94	3.52	2.98
	N.S.	N.S.	*	*	**	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	**	**	1
WESTERN RAJASTHAN															
"b"	-3.19	-22.93	0.609	-0.9	-4.15	-3.12	0.745	0.31	-0.64	-2.05	1.64	2.45	-0.59	-3.26	-2.79
"Sb"	4.99	2.91	2.19	0.23	0.875	0.72	0.505	0.64	1.02	1.225	2.76	2.24	0.445	0.76	0.565
"t"	-0.64	-7.88	0.278	-3.91	-4.75	4.33	1.47	0.484	-0.627	-1.67	0.59	1.09	-1.30	-4.29	-4.94
	N.S.	**	N.S.	**	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	**

NOTES : N.S. = Non Significant

* = Significant at 0.05 per cent

** = Highly significant at 0.01 per cent

STATEMENT SHOWING THE PERCENTAGE OF GROWTH RATE AND STANDARD ERROR OF THE GROWTH RATES OF IMPORTANT CROPS AND GROUPS OF CROPS IN DIFFERENT DISTRICTS OF WESTERN RAJASTHAN DURING 5 years from 1969-70 yo 1973-74

ricts	BAJRA			JOWAR			WHEAT			BARLEY			GRAM		
	A	P	Pr	A	P	Pr	A	P	Pr	A	P	Pr	A	P	Pr
	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
RER															
"b"	20.40	15.30	-32.90	-9.00	7.20	-8.90	9.00	3.70	-9.70	-12.70	-8.90	-0.90	-8.20	-16.20	22.80
"Sb"	2.83	18.24	49.36	22.32	9.22	8.29	6.10	11.34	3.94	5.05	13.81	4.91	5.52	18.49	17.78
"t"	7.21	0.84	- 0.67	-0.40	0.78	-1.07	1.51	0.33	-2.46	-2.51	-0.64	-0.18	-1.49	-0.88	1.28
gnifi-	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
nce															
KANER															
""	-8.80	8.10	-14.90	30.90	4.50	-39.20	43.60	32.20	-11.00	7.90	1.50	-2.70	49.00	63.60	-18.10
b"	6.44	6.72	9.15	7.15	9.61	13.95	21.86	18.42	4.08	13.43	10.20	2.26	8.52	22.48	3.52
"	-1.37	1.21	- 1.63	4.32	0.47	- 2.81	1.99	1.75	- 2.70	0.59	0.15	-1.19	5.75	2.83	- 5.14
gnifi-	N.S.	N.S.	N.S.	*	N.S.	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	*	**
nce															
URU															
"	0.40	-1.50	-21.70	-14.50	-11.40	4.70	9.70	3.00	- 9.80	-12.10	-33.30	-26.00	-7.90	-20.60	-30.10
b"	1.00	6.20	11.49	13.59	12.49	33.30	7.35	14.77	4.43	6.22	10.15	4.33	1.72	5.18	3.21
"	0.40	-0.26	1.89	1.07	-0.91	-0.14	1.32	0.20	- 2.21	-1.95	-3.28	-6.00	4.59	-3.98	- 9.38
gnifi-	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	**	*	*	**
nce															
SALMER															
"	-18.70	-5.70	- 1.00	4.90	1.00	-41.10	-0.40	30.00	- 8.80	-17.60	-1.00	-10.50	27.30	16.00	- 9.10
b"	3.28	16.13	17.86	-6.17	35.29	13.08	12.71	9.84	3.49	5.39	24.60	35.32	4.59	4.62	4.47
"	- 5.70	-0.35	- 0.06	0.79	0.03	-3.14	-0.03	3.05	2.52	-3.27	-0.04	- 0.30	5.95	3.46	- 2.04
nifi-	**	N.S.	N.S.	N.S.	N.S.	*	N.S.	*	N.S.	*	N.S.	N.S.	**	*	N.S.
nce															

contd...

Districts	Total Foodgrains			Pulses			Non-Foodgrains			All Crops		
	A	P	Pr	A	P	Pr	A	P	Pr	A	P	Pr
1.	17	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	29.
1) BARER												
"b"	19.10	- 7.40	-5.50	13.00	9.90	30.80	16.70	8.80	-1.40	19.00	8.70	-14.10
"Sb"	2.76	10.00	8.69	26.65	17.51	15.48	8.54	3.36	11.60	3.03	3.41	9.38
"t"	6.92	- 0.74	-0.63	0.49	0.57	1.99	1.96	2.62	-0.12	6.27	2.55	- 1.50
Significance	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	N.S.	N.S.
2) BIKANER												
"b"	8.00	-20.20	-28.30	-5.00	3.00	53.60	3.00	-15.40	-2.50	1.40	-12.30	-14.30
"Sb"	1.83	3.45	4.64	2.69	2.52	11.24	4.85	12.17	15.41	1.38	3.25	3.20
"t"	4.37	- 5.86	- 6.10	-1.86	1.19	4.77	0.62	-1.27	-0.16	1.01	- 3.78	- 4.47
Significance	*	**	**	N.S.	N.S.	**	N.S.	N.S.	N.S.	N.S.	*	*
3) CHURU												
"b"	1.50	5.50	41.00	-9.10	-10.90	10.80	-13.50	-50.10	-47.00	-3.40	-0.20	1.80
"Sb"	0.66	2.13	10.47	2.86	6.27	6.60	2.65	8.81	8.52	1.28	2.83	2.48
"t"	2.27	2.58	3.92	-3.18	-1.74	1.64	-5.09	-5.69	- 5.52	-2.66	-0.07	0.73
Significance	N.S.	N.S.	*	*	N.S.	N.S.	**	**	**	N.S.	N.S.	N.S.
4) JAISALMER												
"b"	-15.10	-5.20	-13.50	13.40	14.40	1.90	15.10	21.50	67.20	-15.10	-4.70	-9.90
"Sb"	3.89	15.93	4.50	3.87	19.33	15.33	9.73	22.29	14.99	2.89	15.88	3.27
" t"	- 5.22	-0.33	-3.00	3.46	0.74	0.12	1.55	0.96	4.48	- 5.22	-0.29	-3.03
Significance	**	N.S.	*	*	N.S.	N.S.	N.S.	N.S.	*	**	N.S.	*

contd....

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
5) JALORE															
"b"	1.50	6.80	5.40	-20.30	-30.00	-24.40	0.30	-7.60	-11.30	10.90	-0.10	-1.30	3.90	-44.50	-5.90
"Sb"	1.46	12.00	9.98	10.99	8.48	8.01	3.45	3.37	3.83	7.48	13.76	5.00	23.54	21.51	7.76
"t"	1.00	0.57	0.55	- 1.85	- 3.54	2.80	0.09	-2.26	- 2.95	-1.46	0.008	-0.20	0.17	2.07	-0.76
Signi-ficance	N.S.	N.S.	N.S.	N.S.	*	*	N.S.	N.S.	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
6) JHUNJHUNU															
"b"	-0.7	-21.60	-14.50	-17.00	1.00	-20.00	-43.00		0.60	4.50	6.70	0.50	2.80	-36.20	-38.10
"Sb"	1.44	7.09	5.56	15.74	14.39	12.21	18.40	16.32	11.58	1.00	14.87	11.73	3.01	2.63	3.43
"t"	-0.49	- 3.05	-2.61	- 1.08	0.07	- 1.64	3.17	2.63	0.05	4.50	0.45	0.04	0.93	13.76	-11.11
Signi-ficance	N.S.	*	N.S.	N.S.	N.S.	N.S.	5.80 **	N.S.	N.S.	*	N.S.	N.S.	N.S	**	**
7) JODHPUR															
"b"	4.40	4.10	1.60	-19.60	-18.10	8.10	4.00	-7.60	-13.50	-12.30	-32.00	32.60	13.10	-3.50	- 1.90
"Sb"	3.04	8.88	9.90	7.66	7.55	11.59	1.60		6.01	6.60	26.26	15.91	3.98	1.25	6.05
"t"	1.45	0.46	0.16	- 2.56	- 2.40	0.70	2.80	0.95	- 2.25	-1.86	1.22	2.05	3.29	2.80	-0.31
Signi-ficance	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.85	N.S.	N.S.	N.S.	N.S.	*	*	N.S.
8) NAGOUR															
"b"	0.20	-26.5	-6.50	2.30	-37.00	-41.00	12.4		-12.00	1.50		1.70	15.10	9.90	-8.10
"Sb"	0.12	33.73	3.28	0.68	19.14	28.41	2.52	3.10	2.90	0.68	-1.40	5.76	5.63	5.58	5.95
"t"	1.67	- 0.79	-1.98	3.38	- 1.93	1.44	4.92	5.70	4.14	2.21	3.99	0.39	2.68	1.77	1.36
Signi-ficance	N.S.	N.S.	*	N.S.	N.S.	**	N.S.	0.54	*	N.S.	-0.35 N.S.	N.S.	N.S.	N.S.	N.S.

contd.....

1.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.
5) JALORE:												
"b"	1.40	3.20	1.10	20.30	15.90	10.40	20.20	-3.40	-14.90	3.70	5.20	1.20
"Sb"	8.17	8.21	7.25	4.07	2.83	6.59	3.63	12.75	24.08	0.55	9.61	7.64
"t"	0.17	0.38	0.15	4.99	5.62	1.58	5.56	-0.27	- 0.62	6.73	0.85	0.16
Signi-ficance	N.S.	N.S.	N.S.	**	**	N.S.	**	N.S.	N.S.	**	N.S.	N.S.
6) JHUNJHUNU												
"b"	0.80	-18.80	-18.30	- 4.70	-14.00	-11.10	-31.90	-35.00	25.80	-1.40	-7.70	-6.30
"Sb"	1.13	5.41	4.21	0.41	7.90	8.15	14.75	9.88	21.48	1.22	8.01	8.27
"t"	0.71	- 3.48	- 4.35	-11.46	- 1.77	- 1.36	- 2.16	- 3.54	1.20	-1.15	-0.96	-0.76
Signi-ficance	N.S.	*	*	**	N.S.	N.S.	N.S.	*	N.S.	N.S.	N.S.	N.S.
7) JODHPUR												
"b"	2.50	2.40	7.70	0.30	2.70	11.00	29.70	10.10	-8.70	3.20	3.60	1.00
"Sb"	0.63	8.32	7.45	1.39	2.54	5.74	19.47	6.54	6.65	0.48	7.10	7.51
"t"	3.99	0.29	1.03	0.22	1.06	1.92	1.53	1.54	-1.31	7.50	0.51	0.13
Signi-ficance	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	N.S.	N.S.
8) NAGOUR												
"b"	0.60	-5.40	-6.30	2.70	-13.40	-15.60	2.90	24.90	19.90	1.30	-13.60	-14.00
"Sb"	0.52	2.94	2.61	0.37	2.06	4.62	2.06	2.17	2.74	0.55	3.61	3.61
"t"	1.52	-1.84	-2.41	7.30	-6.50	- 3.38	1.41	11.47	7.86	2.36	3.77	- 3.88
Signi-ficance	N.S.	N.S.	N.S.	**	**	*	N.S.	**	**	N.S.	*	*

contd.....

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
9) PALI															
"b"	4.30	4.80	1.20	-12.1	-11.60	-1.20	12.20	11.50	-0.10	3.40	5.40	-0.50	-20.40	5.30	-11.60
"Sb"	1.10	12.55	11.83	11.23	19.52	8.91	1.70	3.21	4.19	1.30	7.19	4.98	9.27	14.14	6.45
"t"	3.64	0.38	0.10	1.08	-0.59	-0.19	7.18	3.58	-0.02	-2.62	0.75	0.10	- 2.20	0.37	- 1.80
Signi-ficance	*	N.S.	N.S.	N.S.	N.S.	N.S.	**	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
10) SIKAR															
"b"	1.00	-23.50	-25.40	-2.40	-6.20	-16.50	14.00	-1.80	-15.70	-7.30	-30.30	-23.20	8.10	-0.50	5.00
"Sb"	0.41	4.09	3.67	11.22	20.61	10.75	1.56	4.88	4.06	2.48	3.39	5.39	6.92	12.80	10.32
"t"	2.44	-5.75	-6.92	-0.21	-0.30	- 1.53	8.97	0.37	- 3.87	-2.94	- 8.97	- 4.32	1.17	-0.04	0.48
Signi-ficance	N.S.	**	**	N.S.	N.S.	N.S.	**	N.S.	*	*	**	*	N.S.	N.S.	N.S.
11) SIROHI															
"b"	5.50	2.10	9.40	2.91	-37.50	-37.90	2.20	-16.20	-28.60	-1.80	- 1.20	- 0.90	-1.70	13.40	-1.50
"Sb"	3.50	10.10	7.51	2.29	14.93	13.29	1.26	5.36	6.65	0.37	5.06	4.78	6.38	4.28	16.91
"t"	-1.57	0.21	1.25	1.27	-2.51	-2.85	1.75	- 3.02	- 4.30	-4.86	- 0.24	-0.19	-0.27	3.13	-0.09
Signi-ficance	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.	*	*	**	N.S.	N.S.	N.S.	*	N.S.

1.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.
) PANT												
"b"	4.20	-13.2	10.40	3.60	8.00	5.80	10.00	4.80	3.10	8.10	12.20	-8.50
"Sb"	1.82	3.89	5.84	3.11	32.02	3.65	3.06	9.67	12.00	1.94	4.54	6.19
"t"	2.31	- 3.39	1.78	1.16	0.25	1.59	3.27	0.50	0.26	4.18	2.69	-1.37
Signi-ficance		N.S.	*	N.S.	N.S.	N.S.	N.S.	*	N.S.	N.S.	*	N.S.	N.S.
) SIKAR												
"b"	1.20	-21.90	-23.40	8.10	-40.80	-13.50	-27.50	-15.00	-13.40	- 0.40	- 5.00	-4.50
"Sb"	0.18	3.67	3.63	6.92	7.91	19.56	3.82	2.89	5.39	0.18	1.22	1.34
"t"	6.67	- 5.97	- 6.45	1.17	- 5.16	- 6.69	- 7.20	- 5.90	- 2.49	-2.22	-4.10	-3.36
Signi-ficance		**	**	**	N.S.	**	N.S.	**	**	N.S.	N.S.	*	*
1) SIROHI												
"b"	0.30	- 9.80	-11.80	6.50	-28.60	-33.00	1.10	2.30	2.40	2.20	-11.00	-3.20
"Sb"	1.97	4.51	4.21	1.26	2.75	2.20	2.35	10.21	13.30	1.08	4.54	3.70
"t"	0.15	-2.17	-2.80	5.16	-10.40	-15.00	4.47	0.83	0.18	2.04	- 2.42	-0.86
Signi-ficance		N.S.	N.S.	*	**	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

NOTES : N.S. = NonSignificant
* = Significant at 0.05 percent
** = Highly Significant at 0.01 per cent.

Identification of Agricultural Sub-regions of West Bengal - an exercise

In the development perspective presented by the Planning Commission in its 5th Five Year Plan a shift of emphasis is observable : while the Second Plan placed priority on 'rapid industrialisation of the country with special emphasis on basic and heavy industries'[1], the Fifth Plan identifies agriculture as 'the most vital sector'[2]. The shift has not come in the evolutionary path of our planning efforts as if the initial tasks of industrialisation having been achieved the country is moving on to an altered path of development. On the contrary, it is an underclared but admitted failure of the earlier strategy and an atmosphere of comparative success in agriculture in the recent past that generated this pressure for deviation from the Second Plan strategy towards the Fifth Plan. A close scrutiny of the series of plan-documents reveals that this movement started from the period of Third Plan and by the time of the Fifth it crystalised into an altogether different strategy of development.

Identification of agriculture as the vital sector of our economy necessitates an evalution of its achievement during the different plan periods. A broad survey of the studies made on this aspect by a large number of authors leads one to assume that there is a general consensus amongst the contries' economists on the following points :[3]

i) That the stagnation in the agrarian structure of the pre-independence period has finally been broken with the achievement of tolerable growth rates of 2.72 in food and 2.45[4] in all crops; and that this has enabled the country to somewhat lighten the gravitating pull of food deficit that was endangering all attempts at regenerating the economy in a planned manner.

ii) That even this limited growth has not been achieved through widespread mobilisation and effective utilisation of human and material resources available in the country; on the contrary, it was achieved through a selective approach of concentrating state aid in areas and sections relatively favourably endowed with productive resources.

iii) That the selective area approach led to accentuation of multi-directional imbalances, latent in a subcontinental economy cursed with the legacy of a long colonial rule.

iv) That the largest beneficiaries of the development efforts were the substantial farmers of better irrigated (especially perennial ones) regions gaining from the biological breakthrough in a particular crop or in other words, disproportionate benefits were reaped by people in command of the marketable surplus from the traditionally irrigated wheat region i.e. the rich farmers and traders of Punjab - Haryana - Western Uttar Pradesh.

v) That the achievement in the agricultural sector was induced by the prospect of continuously rising prices of agricultural commodities in general and foodgrains in particular.

vi) That input price of labour failed to rise pari passau with other factors of production in areas of higher growth.

vii) That there was a district swelling of ground rent expressed in fast increase of land value in different region.

viii) That the above factors working in conjunction did give rise to concentration of economic and political power not conducive to the maintenance of a high growth rate and apparently detrimental to a more egalitarian spatial and vertical distribution.

ix) That at the level of this moderate achievement in agricultural growth there are reasons to doubt the stability of the trend of improvement. There is a lurking apprehension that the physical growth rate of vital crops like wheat is showing a tendency to taper off and that the imbalances generated in the growth process itself have started putting brakes on the growth rate in the agrarian sector.

A deeper study of factors contributing to agricultural growth in different regions is therefore urgently called for. Table 3 contained in the Fifth Plan document itself very succinctly summarises the contemporary situation by pointing out that 12.41% of districts in India achieved a compound growth rate ranging between 5 to 11 per cent in the gross value of output while 37.59% of districts registered less that 1 per cent rate of growth and about 25% (24.82%) of the districts has absolutely negative growth rates. In other words, the nation's desire for a resolution of the growth vs. equity' problem has met with frustration in so far as the areas of high growth are completely offset by areas of negative growth.

II

West Bengal's Specific Constraints

This paper, sets out to focus attention on the regional constraints of the state of West Bengal, where macro indicators reveal a chequered path of growth in the agricultural sector during the plan periods. West Bengal did enjoy a comparative edge in agricultural productivity till the early 50s. It s started lagging behind in the first few plans.

The factors responsible for inhibiting West Bengal's response to strategies of faster agricultural growth popularly known as 'green revolution' and the state's difference with so called success regions of green revolution may be summarised as follows :

Although land reforms in West Bengal during the nineteen fifties considerably removed some of the basic maladies of feudal and semi-feudal exploitation and consolidated the position of ryots and under-ryots, the agro-economic structure that evolved during the recent period has not been conducive to rapid growth in agriculture, largely due to the fact that tenancy reforms could neither provide security to share-croppers nor create any significant dent in the behaviour pattern of large landowners.

Unlike Punjab and Haryana where big farmers lease in land from small and medium peasants, the large landholders of West Bengal lease out a considerable proportion of their lands to small farmers against a high rent-share of 50 per cent of the produce. Share-cropping which involves more than 30 per cent of the total agricultural work-force and more than 40 per cent of the total arable land has remained to be the prevalent mode of tenancy - farming in West Bengal.

Rack-renting, usurious money-lending and speculative trade have been the principal methods of the rural rich for appropriation of a substantial part of the surplus coming from a agricultural production. The surplus thus appropriated, instead of being invested for expanding the productive opportunities in agricultural sphere, is used by the rural rich mainly for the maintenance and consolidation of the pre-capitalistic trade-cum-financial instruments of exploitation and partly for conspicuous consumptions.

A partial answer to why large landowners prefer to keep away from productive investment possibly can be traced in the powerful legacy of the Permanent Settlement, but a fuller explanation should also take into consideration the contemporary and technological changes.

Let us first admit that the average net cultivated area per rural household (2.55 acres) is much lower than that of the agriculturally more advanced states like Punjab (5.45 acres) Maharashtra (6.80 acres) and Gujarat 7.39). The last two states however, have large arid tracts. Soupled with this intense pressure of population on agricultural land is the fact that by far the largest section (69.25%) of the agricultural households belongs to the category of landless labourers and poor peasants (less than 2.50 acres each). A further 16.81 per cent of the households belongs to the size-class of 2.50-4.99 acres. Both these percentages are above the national average and significantly higher than those in Punjab and Haryana. The land-scarce and labour-surplus economy characterised by a preponderance of small and poor peasants, unrecorded and unprotected sharecroppers and almost complete absense of secondary employment naturally provides the ground for the counter-productive role of large landowners.

Two other features of West Bengal's agrarian economy which strengthen this role are the widespread and perpetual indebtedness of poor farmers and cultivating labourers and the existence of large and quick profit opportunities through trade. Being constrained by the lack of access to organised credit agencies, share-croppers and poor peasants are compelled to borrow in kind during the lean season. Kind loans valued at prices obtaining in a sellers' market have to be repaid in amounts of grain determined at loan prices in the immediate post-harvest market to cover the money equivalent of the debt. The rate of interest on such loans for a short period of four to five months ranges between 50 per cent and 300 per cent of the pricipal amount. This consumption loan is generally a business of the large landowners.

Since a substantial part of their own surplus is alienated by large owners, the small producers are also not free from this trap. With minimal staying power the small producers often have to sell their harvest at distress prices to the large landowner-cum-trader-cum money landers. All this, together with the short-supply in foodgrains and other essential commodities, continuing price inflation and sharp fluctuation in productivity help the large owners to make full use of the market mechanism to their advantage.

Thus while the big landowners can afford to thrive with a perfectly parasitic behaviour pattern and lack the basic motive for productive investment, the small and poor peasants find it totally beyond their means to modernise agriculture.[5]

The above summary more or less adequately describes the lag in West Bengal's response to efforts at intensive agricultural development till the mid-sixties. Since 1967-68, however, and more pronouncedly from 1970-71 indications of inprovement are observable in the state's performances in the agrarian sector (Table 1).

III

The Case for Disaggregation

Improvement in West Bengal's agricultural performance has been registered mainly in the food front. Tables 2A & 2B show clearly that the overwhelming share in the incremental margin is accounted for by wheat and boro (summer paddy) both circumscribed by limits of non-monsoon irrigation facilities in the state. Within the state, therefore, this has led to areas of enclaved prosperity fraught with all the dangers mentioned earlier in the all-India context. The subsequent section, therefore tries to trace in detail socio-economic implications of this phenomenon in a comparative-static framework covering the post-independence decades.

As we are looking for sub-regional constraints within the boundaries of the political entity called West Bengal, it should be mentioned that the choice of variables is primarily restricted by paucity of reasonably dependable data even at district level. The matrix of correlations (Table 11) presented lacks two vital components - variables related to investment and land ownership. On both these items single time point data is available up to the N.S.S. zone level only. The N.S.S. zone's however, for purposes of numerical homogeneity, have been demarcated in a way that does not suit our purpose. Hence the same could not be used.

An examination of the matrix of correlations pertaining to 1970-71 reveals that when aggregated at state level, even obviously expected relations as between, say, the incidence of scheduled castes and tribes with percentages of agricultural labourers and/or percentage of literacy get blurred. Two major dimensions however stand out despite the limitations of such an aggregation. These are (i) significant relationship of irrigation with productivity and value of output per unit of land, and (ii) a tendency of clustering of indicators of backwardness in less dense, non-irrigated areas of the state with larger incidence of tribal population.

Land-man ratio (X_3) bears a positive relationship with percentage of agricultural workers (X_2) in the rural work force, negative correlation with percentage of literacy (X_6), food and non-food output (X_{16}, X_{17}, X_{18}) and weak positive relationship with percentage of scheduled tribes in the total rural population (X_4). Or in other words, an area of comparative backwardness gets delineated by greater dependence on agriculture in less irrigated zones leading to lower output and decreased capacity of sustaining population. The load of illiteracy in the above mentioned region is also higher.

On the other side, we find percentage of irrigated area (X_{10}) positively related to gross output (X_{18}) both in physical and value terms and positively though weakly related to percentage of literacy (X_6).

Another interesting aspect observable from the same matrix (Table 11) is that while productivity indices are broadly related to irrigation there appears to be greater correspondence between areas of canal irrigation (X_{11}) and areas of higher productivity in food (X_{16}). A positive though weak correlation between tubewell irrigation and productivity in non-food crops (X_{17}) only points to the role played by irrigation in general and its source-wise variations.

The fact that west Bengal's agriculture performance has shown distinct improvement in the recent past mainly in production of food alongwith our observation that area and production of food have positive correlation with irrigation leads us automatically to choose irrigation as a major classificatory variable for a disaggregated analysis of the state level inter-relationships.

Before entering into district level analysis it need be mentioned that the districts of Calcutta and Darjeeling have been kept out of our perview. Exclusion of Calcutta should come automatically in view of its total non-agricultural character. Darjeeling has been omitted because of its atypical topography, land system and nature of enterprises. Tea-plantations and forestry are much more important enterprises in Darjeeling.

Further, it is necessary to point out at this stage that most of our analyses and discussions had to be carried out by taking districts as the ultimate unit. The districts are political administrative units only and more often than not are non-homogeneous in physical and/or techno-economic terms. This point has been argued at a later stage of this paper with the help of a few illustrative cases. We have to accept this constraint only because of paucity of data at levels lower than the district. We are however convinced that further disaggregation at least up to the police station level will get us at meaningful regional homogeneity of character relevant for our discussion.

Table 14 presents the 14 districts (excluding Calcutta and Darjeeling) with their percentages of irrigated to gross-cropped areas ranked in ascending order. The table helps us identify three distinct levels of irrigationsl developments in the state. Three districts namely Birbhum, Burdwan and Hooghly from a zone of moderate of high irrigation (zone A), the percentages being much higher than the stage average of about 23 per cent. Similarly at the bottom we find 5 districts namely 24-Parganas, Malda, Coochbehar, West Dinajpur and Nadia where the percentage of irrigated area is lower thar 10 per cent (zone C) of the gross cropped area. The residual 6 districts may be considered to form the intermediate zone having a percentage range of 15-40 (zone B). Having demarcated the irrigation subregions in the foregoing manner let us examine how far the irrigation advantages are reflected in terms of the agrarian prosperities of these districts.

Ranking districts in terms of their irrigation and value productivity we arrive at a correlation value of 0.58. This gives us the notion of a moderate correlation between a district's irrigation and value productivity of agricultural land (Table 14).

The rank correlation value improves considerably if we exclude Nadia and Purulia from the paired rank series. The correlation in that case becomes 0.78. The erraticity of the deviant districts will be discussed separately in the subsequent section. A super imposition of maps of irrigation and area-wise value productivity clearly demarcates a cluster comprising the

three districts of Birbhum, Hooghly and Burdwan. Notwithstanding minor anomalies this region can reasonably be identified as the node of development in the West Bengal context. Having demarcated this area (zone A) of enclaved prosperity we now propose to examine the characteristics of the area in a greater detail. / This is necessary to corroborate our hypothesis that degrees of variation in the presence or absence of the same factors helps at least partially, in explaining the resultant character of larger parts of the remaining areas of West Bengal constituting Zones B and C in our table.

IV

Sub-regional Characters

Zone A

The initial natural advantages for agricultural enterprise in the area constituting Zone A - Birbhum, Burdwan and Hooghly, derives mainly from the fact that it lies at the confluence of two important river regimes namely, the perennial snow-fed Himalayan system and the flashy Chhotonagpur streams.[6] The area does not share either the excess water hazards of the lower plains of Bengal or the acute run off problems of the western plateau fringe. This area benefited from the establishment of one of the earliest modern canal systems, the Eden Canal (1885). A much larger irrigation reinforcement was introduced in the same region, first through the old Damodar Canal and subsequently the broader D.V.C. complex. The particular district within this zone which did not enjoy these initial advantages is Birbhum. It did not have the benefits of these three canals of the Damodar Valley, but subsequently the creation of the Mayurakshi system of Canals in the early fifties helped considerably in removing this handicap of Birbhum.

The gradual consolidation of the irrigation infrastructure in the area favouring more intensive enterprise in agriculture gave rise to a relatively vigorous peasant community, notwithstanding the overall feudal load of the permanent settlement. It may be worthwhile to note in this context that the system

of share-cropping that inhibits the toiling peasantry's enterprise, though not uncommon in this region, had lesser weight in the overall land-management practice particularly around the period of independence. Unlike the flood-affected lowlying plains of West Bengal (i.e. North and South Bengal) share-cropping tenancy was not the major form of land-management in this region, particularly in Burdwan and Hooghly. In other words the social hegemony of the land owning peasantry was comparatively more developed in this region. Hooghly's proximity to Calcutta metropolis and Burdwan's advantageous location in between the industrial regions on the banks of river Hooghly and the coalfields of western Burdwan coupled with elaborate road and railway transport network added to the prosperity of the agrarian economy of this hinterland. In this respect too Birbhum was initially at a disadvantage. It did not either fall on the main rail-road axis[7] nor had the advantage of improved intra-district road network. The turbulent Ajoy's presence bordering Birbhum and Bardwan kept the former in a position of relative insularity. Similar to irrigation Birbhum's transport handicap was partially overcome by the construction of a vital road-bridge across the Ajoy. The initial handicaps of Birbhum thus seem to considerably explain its late entry into the prosperity enclave as also the minor rank difference between irrigation and value productivity. In terms of institutional framework Birbhum gave birth to the atypical system of kishani, a mix between share-cropping and contract labour.[8] Extension and consolidation of irrigation from the Mayurakshi system gradually started pushing kishani to non-irrigated parts while the irrigated areas were cultivated more by mahinders (hired farm servants) and munishes (casual daily labourer). The temporal changes in the forms of labour supply, a vital relationship in the agrarian system will be discussed presently in some more details.

Crop-wise the zone offers interesting variation. Hooghly's edge in the value productivity rises out of its proximity to the metropolitan market of Calcutta. Over and above the traditional jute cultivation, parts of Hooghly just after the Second World War went in for vegetable cultivation in general and potato cultivation in particular. The disadvantages arising from the smallness of average size of holding in Hooghly[9] was largely offset by introduction of intensive potato cultivation as a rabi crop irrigated by tubewells and

helped in marketing through development of cold storages.[10] Burdwan and Birbhum started making up only after the introduction of the Mayurakshi and D.V.C. When regions proximate to the canals started using residual kharif water for HY wheat in rabi and HY rice in summer (boro). It need again be pointed out that while we are forced to discuss at present at a district level the specific crop (single or combined) tracts cannot really be delimited in terms of the district boundaries. For example, the intensive potato tract has a considerable overlap in Burdwan though in relative terms potato plays a more important role in Hooghly than wheat does. Similarly the HY summer rice cultivation based on DVC waters has come only to specific parts of Hooghly while the same plays a more important role in Burdwan.

An examination of the pattern of labour supply reveals that all the districts within the zone under reference has a more than average (state average) percentage share of hired agricultural labourers in their respective agricultural workforce. Birbhum's agricultural labourers constituted 44.19 per cent of its workforce in 1971 as against 27.52 in 1951. The increase within the last two decades seems to be the result of a large conversion of kishans into agricultural labourers over and above the accretion in the same due to national demographic increase. The share of agricultural labour in only 21.65 per cent in 1961. The same for Hooghly for 1951 was 23 per cent from where it jumped to 40.83 per cent in 1971.

While presenting the data on agricultural labour as indicators of variation in the production relation we are fully aware that the number of agricultural labourers as enumerated in the past three censuses do indicate the emergence of a growing freely competitive labour market, it should not create any misconception that these categories are free from instrusion of de-facto share-croppers.[11] Yet, the lower percentages of tenant cultivators and increasing percentage of agricultural labourers overtime tend to suggest a situation slightly deviant from the semi-feudal mode of labour-employment that even today characterises large parts of the Plains of Bengal.

To sum up it may be pointed out that this prosperity enclave in its larger part had initial geographic advantages which were reinforced by modern irrigation network of canals and tubewells in certain pockets. Land-owning peasants especially after the removal of Permanent Settlement intermediary

rights on land and with subsequent access to organised credit did turn this area into a relatively prosperous economic zone by greater use of hired labour-based owner cultivation, more profitable crop-mix and concentrated use of subsidised material inputs in a favourable market situation. The initial handicaps of Birbhum in irrigation and transport could also be overcome through public investment. But this achievement was possible through a greater dependence on hired labourers with pegging real wages[12] or in other words attended by a sharper polarisation of the society.

Zone C

If we exclude Nadia, the deviant district in this set we have four districts, 24-Parganas, Malda, Coochbehar and West Dinajpur laking in agricultural prosperity. The case of Nadia shall be discussed separately in this section. Of the four aforementioned districts three belong to the plains of North Bengal and the other in southern West Bengal, the newly forming delta of Bay of Bengal that includes within its fold the West Bengal part of the Sunderbans.

The picture could have been brought to sharper focuss if we could exclude parts of north 24-Parganas which is closer to and largely part and parcel of the industrial complex around Calcutta than the deep southern areas and Barind.[13] The Diara and Tal areas of Malda share characteristics more with the Gangetic part of Murshidabad and Nadia. In contrast to the western part of West Bengal, North Bengal irrigation infrastructure never meant insufficiency of water in the main kharif cultivation. On the contrary larger areas of North Bengal Plains suffer from excess water hazards during the monsoon i.e. kharif cultivation.

The problem of excess water in North Bengal arises mainly because of the following three interrelated factors : (a) its location at the foothills of the Himalayas, (b) the excessive flatness of the plains just at the base of the massive mountain ranges, (c) the specific geological formations of the area. The vicinity of the Himalayas results in larger monsoon precipitation while the snow-fed rivers directly disgorge large volumes of water on to the plains. For the same reason, the soil consists of unconsolidated snads and grabbles causing recurrent changes in the courses of the numerous rivers that drain the area.

The kharif cultivation, therefore, in North Bengal, though enjoys relatively more precipitation, always suffers from fluctuations in yield due to frequent floods from shifting river courses. Thus the natural factors operating in North Bengal Plains allowed the continuation of a near zero investment with fluctuating but easy returns from the kharif cultivation. It may be mentioned here that though broadly under the Permanent Settlement arrangements, larger areas of North Bengal were not found suitable for ryoti settlement. Instead it was brought under cultivation through leases. The presence of a large semi-tribal population, mainly Rajbanshis/Koch/Polia, allowed the absentee landlords and leaseholding jotedars to bring about a form of land management, overwhelmingly based on share-cropping locally known as adhiari. To indicate the extent of problems emanating from adhiari system it may be recalled that the two most important poor peasant upsurges-Tebhaga on the eve of independence and Naxalbari in the mid-sixties were direct results of this retrograde system of land management.

Further, North Bengal's comparative distance from the development nexus from Calcutta also played some role in keeping the area in isolation and backwardness. The natural hazards reinforced by the tremendous load of adhiari system did not allow the emergence of a vigorous peasant agriculture capable of tackling even partially the irrigation and other problems inhibiting a more intensive enterprise in a problematic terrain.[14]

That some improvement is possible notwithstanding the need for a large-scale state intervention in taming the Himalayan rivers that may result in a drastic change of the face of North Bengal has been demonstrated in the recent past. This has been achieved on the one end by small enterprising low caste refuge peasants of East Bengal (now Bangladesh) and state aided 'gentleman farmers' on the other. Crop-wise this is reflected in the post-seventy spread of wheat cultivation in upland areas of North Bengal Plains particularly Jalpaiguri. In fact these developments have helped Jalpaiguri to move itself up into Zone B of our categorisation.

The district of 24-Parganas, more specifically southern 24-Parganas suffer from ailments largely similar to the plains of North Bengal with a different ecological context. The group of estuarine islands constituting major parts of 24-Parganas grew out of the natural delta-building activities of the distributaries of the Ganges syste. The process essentially consists of the interaction between the southerward run-off of the distributaries and the northward moving tidal insurgences. The resultant estuarine deposition led toemergence of land blocks at or near the sea level, separated by innumerable channels and cross-channels. The same process created natural levees along the banks of the river, surrounding saucer-shaped depressions. Unfortunately, the process of natural land formation was not allowed to mature itself. The tremendus population pressure and greed for turning the immature delta into an arena of easy profit interfered with this natural process. Embankments on the natural levees were built in order to stem incursions of saline water. This left the inner land surface in an extremely problematic state for suitable and prosperous cultivation. This handicap could have been overcome had there been agencies for large long-term investments for proper land reclamation. This task went by default for reasons well-known to economic historians. The whole responsibility of bringing this area under some sort of cultivation was cunningly shifted on to the land hungry poor cultivators and the rural labour force spilling over from the densely populated district of Midnapore and also from the eastern Bengal districts and large-scale immigration of tribal labour almost by indenture from the Chotonagpur region. As a disgression it may be mentioned in this context that all these labourers were brought into the area with thellure of land but were actually settled as share-croppers in very unfavourable terms. The persistence of salinity, depression in island sectors and the rapacious suction of major parts of the produce raised with intense labour under extremely difficult conditions perpetuated a state of backwardness in the agrarian society of this region.

We have noted that though by standards of artificial irrigation Nadia's position is at the bottom of our table yet in terms of value productivity the district figure at a much higher level than many others in the state. This deviation seems to stem very largely from Nadia's natural condition. Unlike 24-Parganas Nadia and the <u>bagri</u> (deltaic) part of Murshidabad constitute the mature-moribund delta of the Ganges, much less burdened with the problem of lowness of level, soil-saline and excess water.

Unlike North Bengal, its soil is composed of finer alluvial clastics. Further, Nadia enjoys proximity to the Tropic of Cancer which gives it a favourable temperature for the cultivation of sugarcane. Nadia, therefore, is endowed with natural factors helping a diversified crop-mix, distinct from the common aman based mono-erop cultivation prevalent in larger parts of West Bengal. In other words, Nadia demonstrates the case of a natural peasant economy in one of the better endowed regions of West Bengal. The favourable tem perature - climate-soil complex is reflected in the larger weight enjoyed by sugarcane in the total value of agricultural production of thedistrict. This in the post-independence period was helped on the one hand by some tubewell irrigation and on the other by large-scale settlement of enterprising refugee peasants, (Namasudras) mainly from Faridpur (now in Bangladesh) a part of East Bengal. Sugarcane and tubewell based multiple-cropping including wheat accounts for t he relative prosperity of Nadia in this zone. Institutionally also Nadia presents the pre-independence agro-economic framework of Bengal with considerable share-tenancy interlaced with small and medium owner-cultivation and with lesser employment of purely hired labour.

Zone B

In Zones A and C we have tried to isolate the areas of comparative prosperity and backwardness respectively. The middling Zone B, however, accounts for larger part of area and population of West Bengal. In this zone, consisting of 6 districts, physiogrophic homogeneity is much less than in the other two zones. This is because the zone is residually defined and demarcated statistically in terms of its moderate development of controlled irrigation facilities, the degree ranging between 15 and 40 per cent. Like Nadia, in Zone C the district of Purulia behaves in a strongly deviant manner within the set as the degree of non-concordance between its irrigation rank (6) and productivity (13) is very wide. In other words, Purulia appears to be almost the counter-point of Nadia where the income rank was much higher than the irrigation rank. The special features of Purulia will be discussed separately after we have discussed the general feature of this zone.

Large parts of three districts of this zone namely Bankura, Midnapore and Purulia may be better understood if we recall

that the old jungle mahals or the ghatawali mahals covered a major part of this zone. Purulia sharing the same physiographic characters was kept separate for political reasons. Parts of Birbhum and Burdwan too were within the jungle mahals.

This area being on the western fringe of the state has a lower precipitation and higher temperature variation. It is deprived of the advantages od deltaic West Bengal. Because of the region's proximity to Chhotonagpur Hills and its undulating terrain, the flashy rivers draining through the region fail to irrigate the area by natural process while the same streams contribute so much to the irrigation facilities in the more eastern parts of their basins. Soils of this region are extremely porous and lateritic in nature. The undulation of the topography coupled with the specificity of soil and proximity to non-perennial river sources beset the area with an acute run-off problem. The area, therefore, failed to develop the features of the socio-economic environment of the wet cultivation dominated West Bengal.

This area became the habitat of tribal and semi-tribal people moving in consonance with the jungle and small hill based ecology of the region. The frequency of droughts resulting in great uncertainty of even the lower yield possible in this region provided the base for a tremendously exploitative fired-produce tenancy system known as sanja. The low yield coupled with proliferation of the high rate sanja tenancy made the stable and poorer people of the region an easy hunting ground for usury and rapacious trade. The complex thus created guaranteed against any growth of peasant enterprise in this region.

Midnapore, the largest district in this zone as wellas in the state of West Bengal, is in many ways representative of West Bengal's problem in agriculture. Geographically, it comprises three sub-regions : (a) a lateritic region sharing characters of the zone described above, (b) the eastern part sharing characters with the more fertile lowlands of Howarh-Hooghly-Burdwan and (c) the estuarine southern part sharing problems described in case of southern 24-Parganas.

Institutionally also these distinct regions throw up different patterns. The south was more burdened by bhagchas (share-cropping), the west by sanja (fixed-produce) and the eastern by a small and medium peasant-based owner-cultivation. It is the third region's prosperity that has succeeded in pushing up Midnapore in the value productivity rank in our table.

Murshidabad, another district in this set comprises two distinct tracts - (a) western rarh and (b) bagri (eastern). The rarh part shares characteristics with Birbhum while the bagri part resembles that of Nadia. The rarh part does not as yet enjoy controlled irrigation facilities to the extent Birbhum does although it has a moderate degree of irrigation from the Mayurakshi system. The inadequacy of the rarh part is somewhat balanced by the natural fertility of the bagri part.

Bankura, another district of this set comprises two distinct areas (a) the lateritic west overlapping into Purulia and (b) deltaic east stretching into parts of Burdwan.

Howrah, the other district of this zone though small in size yet lacks physiographic homogeneity. Howrah's higher position in the productivity-prosperity ladder in our classification mught be easily explained in terms of its proximity to Calcutta and the large industrial component of its economy, but its agricultural hinterland could not come up to the extent Hooghly and Burdwan did as its southern half face problems similar to those of estuarine Midnapore and 24-Parganas. It also suffers from the excess water problem accentuated by its location at the tail-end of D.V.C. system. The oft-repeated problem of drainage of the lower Damodar Valley is very much a problem of southern Howrah. In the other parts of Howrah we find the advantages of a fertile deltaic situation. The northern areas, however, have the improved infrastructural facilities of Hooghly and Burdwan. Thus Howrah, the smallest district alongwith Midnapore the largest one both within this set allegorises the problems of agricultural development of West Bengal.

Institutionally also, we find an admixure of owner-cultivated small and medium peasant agriculture with considerable interlacing of share tenancy. In case of Howrah the share tenancy in the non-estuarine part similar to Hooghly arose out of an urban industrial occupational bias, the middle and poor families maintaining relationship with land due to its proximity to their place of non-agricultural occupations and pursuits.

Jalpaiguri, the only district of North Bengal entering into Zone B, is not physiographically different from other parts of the region. Only in the recent period the enterprising low caste peasants and gentleman farmers emerging from the moribund tea-cum-jotedari-cum-construction business has brought in rabi irrigation in some enclaves. It is interesting to note that deep tubewell facilities are more enjoyed by gentleman farmers while shallow tubewells are used more by small enterprising cultivators,[15] The real bottleneck in case of Jalpaiguri however remains in the proliferating de-facto adhiari and unhinged Rajbanshi rural poor around the decadent giri-adhiari system. The system received a jolt in the recent period and gave birth to bimodal intensive agricultural pockets.

Thus we may sum up the character of the intermediate Zone B as a conglomerate of all the physical features and institutional aspects that gi e rise to the problems and prospects of West Bengal's agrarian development.

Caste and Literacy

In the preceding parts of this paper we have confined ourselves to the discussion of spatial variations in ecolovy, irrigation and institutions of labour supply. Among a host of other relevant factors that are expected to interact with the forms and efficiency of agricultural enterprise, the sociological categories of caste and literacy have been taken account of in the list of selected variables. It has already been noted that the average degree of inter-relationships between caste and literacy or of their correlations with other economic performance indicators does not bear out usual assumptions. Scheduled Castes do not figure as a major explanatory variable in our exercise chiefly because of the fact that there is a overlap between the up and coming peasant castes and the socio-economically lagging scheduled castes. We have, however, within the limited scope our zonal level analysis, been able to show that the 'tribes and semi-tribes', often indistinguishable from one another due to their position in the tribe-caste continuum, have been shelved into areas of comparative socio-economic backwardness. In other areas where tribal components constitute relatively smaller segments

tubewells at economic costs.

In case of the lateritic western margins one has to admit that given the limitations of the regions' natural endowment it may not be wise to think of turning it into a wet-crop one. We have to think in terms of a judicious mixture of dry-farming-cum-tree-crop economy with the existing wet-farming system of the river margins. Considerable parts of the drier medium lands of this region can be brought under kharif cultivation by improving upon the practice of jorbundh irrigation - a system of putting small temporary earthen dams across short-lived monsoon rills by absolutely rudimentary techniques developed by local cultivators to irrigate small pockets of land during drought spells. This would need larger mobilisation of the labour force and a supporting institutional set up of the toiling poor for the proper protection maintenance and utilisation of its productive potential.

In the relatively higher regions of this area a method od dry-farming of even high-value crops like sugarcane has been made to prosper. The method is one of trapping the dewy precipitation in the absence of rainfall by sheer intense labour. This method is also feasible for a communal organisation of the toiling poor if adequate help is offered not only in supplying inputs but also in graranting remunerative prices for the fruits of intensive labour. Forests inter-mixed with fodder areas offer nother alternative avenue for the dry uplands of Purulia, Bankura, Midnapore and like areas. There is no reason why rearing of silk cocoons (previously practised in this area) and development of dairy farming can not prosper in this region given the proper institutional climate.

In the western drier parts, communal mobilisation of the toiling poor for a labour intensive strategy of development is both feasible and essential. This cannot be done by helplessly treating the area as a permanent dole-relief sustained zone giving birth to a parasitic orientation to an otherwise struggling poor base. Partisan intervention for eradicating all forms of sanja-cum-usury and plan for setting up numerous cooperatives of poor producers and labourers to build, maintain and govern the small and medium irrigation schemes with state aid and diversified dry-farming-cum-forest based cultivation and industry (silk, lac fruits etc.) including dairy farming through state supported co-operative institutions covering all stages from production to marketing is desirable and feasible.

The south Howrah-24-Parganas problems of drainage, salinity and land development again is essentially a product of defective technical planning (as in the case of lower Damodar) aimed at enclaved development, divorce of license to private profit oriented use of natural resources both at the expense of nature and society at large. It may be noted here that it is never the jotedars but the poor peasants that built up and used to look after the elaborate embankment network of southern Bengal. Their gradual and by now complete estrangement from the system as a result of the counter-productive institutions of the lease-holders and fish traders at the cost of poor share-croppers and labourers has made the problem as acute as it is to-day. Breaking the dominance of the jotedar-cum-fish magnets by strict implementation of land reform provisions and distribution of vested land coupled with setting up of cooperative modes and calling upon the overwhelming poor of the region for protecting and developing the region on communal basis seems to us to be the only real alternative. Apart from the lessons of China in resolving the problems of its large-scale and complicated hydrological problems, that were hindering her agricultural growth, essentially through the mobilisation of the rural poor and making full use of their innate visdom and creativity alongwith continuous stoking of their better capability of communal action, we have edidences of at least two viable cooperative ventures of the rural poor effectively tackling problems of irrigation and agrarian development in two different regions of West Bengal. One of them, the maturer one, is functioning in an excess water pocket of 24-Parganas while the other, a tribal one is fighting hard to make a dent in the drier parts of P urulia.

North Bengal as we have admitted earlier faces a problem which needs much more state intervention in so far as the damming of its rivers is concerned. Socio-economically it is a problem of providing infrastructural support for generating newer mode of utilisation of an otherwise bountiful nature. The older Giri-adhiari absentee landlord system surviving on an uncertain monc-crop cultivation exploiting the semi-tribal people in a semi-insulted economy started decaying since the late forties of this century and more particularly in thepost-independence and post-partition era. The low-level equilibrium of the old eco-system received a severe jolt but has not been replaced by a new system encompassing the whole. There are only enclaves of development surrounded by the ruins of the system. The task of demolition has to be completed through

land reforms. But experience of land distribution[16] unattended by the development of a modernised cooperative organisation of the poor has not borne out the the desired results in the last decade. Distribution of land rights in small parcels on individual basis affected during the two spells of the United Front Government did not result in a thriving poor peasant agriculture. On investigation undertaken by one of the authors it was found that most of the land redistributed had passed on to non-title holders within a few years. On the other hand, prospects of getting consolidated areas for cooperative efforts are much more in North Bengal. North Bengal peasants' traditional character partially reflected through movements like Tebhaga and Naxalbari does raise hopes that community oriented solutions have a greater chance of success in that area.

We have so far pointed out the regional technological constraints of West Bengal's agrarian economy as also different institutions inhibiting its growth reinforcing backwardness and their interactions in developing a proper atmosphere for vigorous agricultural enterprise. In connection, we submit that the remedies already suggested demand not only expertise and legal and governmental intervention, but also mobilisation and identified participation of the so-called 'problematic rural poor' in not only solving their own problem of existence but taking initiative in regenerating the country's economy as a whole. This is beyond the capacity of any chosen set of entrepreneurs differentially aided through better infrastructure and package of modern inputs and guarantee of a continuously high profit market. Its counter-productive effect already evident in areas of so-called 'green revolution' is bound to be much worse in an overpopulated problem-ridden state like West Bengal.

AGRICULTURAL DEVELOPMENT IN ASSAM

I. The General Background

K. Saigal

Population Growth :

1.0. Census data shows that Assam has one of the highest demographic growth rates in the country, the growth in the decade 1961-71 being 34.95 per cent against 24.80 percent for all India. During the last half century (1921-71), the growth of population in Assam has been 21.5 percent. This high rate of growth is not entirely due to biological cause. A significant portion of the increase is due to the influx of people from outside and this trend has been continuing at least since the beginning of the century, as the table 1.1 will show -

TABLE : 1.1

Trend of Growth of Population

	1901	1921	1941	1951	1961	1971
All India Population (million)	238	251	319	361	439	548
Assam population (million)	3.3	4.6	6.7	8.0	10.8	14.6
Assam as percentage of all India	1.4	1.9	2.1	2.2	2.5	2.7
Estimated Decadal migration as percentage to Assam population		9	N.A.	6	11	7
		(0.4)		(0.5)	(1.2)	(1.0)*

* Figures in brackets show net migrants in million.

Income Growth :

1.1 Against the high demographic growth rate, the economic growth in Assam has been entirely inadequate and incommensurate. Because of the inadequate growth rate compared to the population growth, the per capita income since 1948, at constant prices, shows a very sluggish growth even as compared to all India, as is clear from table 1.2 - (for a real comparison of incomes at the all India and Assam levels, the comparative purchasing power of money has to be taken into account to ensure that like is compared to like. It has been calculated that there is atleast 20 percent higher cost of living in Assam as compared to the All India average. Suitable adjustment for this has been made in the income figures given in the last 2 columns for Assam in the table below):

TABLE : 1.2

Comparison of National Income and State Income of Assam

(Rupees in crores)

	Total Income*			Per Capita Income (in Rs.)			1970-71 Income at comparable prices @	
	1951-54	1969-72	Growth rate	1951-54	1969-71	Growth rate	Total income (in crores)	Per capita in Rs.
1	2	3	4	5	6	7	8	9
All India	9778	18695	3.7	274.6	345.4	1.3	34253	633.1
Assam	208.3	390.5	3.6	248.6	271.4	0.5	606.2	422.1

* All India estimates at 1960-61 prices, and Assam estimates at 1948-49 prices.

@ Estimates for all India for 1970-71 at current prices. For Assam the estimates are at 1970-71 prices deflated by 20 percent.

Unless the domestic product rises faster than the population a stagnant or backward trend will continue. It has been observed that the per capita real income went down in the year 1951-52, 1953-64, 1956-57, 1962-63, 1965-66 and 1969-70.

Poor though the per capita income of India is, inequality between Assam and the rest of India is a cause for social tensions militating against the cohesion of society and the integrity of the country. Perhaps no more telling picture is required to bring home and chromic economic stagnation in Assam. However, examination of the other trends, explained hereafter, also supports this picture.

Agricultural Production Trends :

1.2 For the local people of Assam, not considering those who migrate to Assam, seasonally or otherwise, agriculture is the mainstay, contributing about 56 percent of the State Income. According to the 1971 census, 65.8 percent of the labour force is employed in agriculture. Because of little or no control

over floods and drought and because of almost non-existence of irrigation and power inputs for agriculture, there is a relatively slower growth in the agricultural production trends compared to all India as is evident from the following table :

TABLE : 1.3

Index of Agricultural Production Assam & India
(base 1956-57 = 100)

	1956-57	1960-61	1965-66	1968-69	1969-70	1970-71
All India	100	115	107	129	138	147
Assam	100	100	108	122	121	126

1.3 The stagnant trend in the production of important crops is brought out by the table - 1.4

TABLE : 1.4

Production of some important crops in Assam during the past few years.

Crops	Units in thousand tonnes	1968-69	1969-70	1970-71	1971-72
1. Rice	"	1990	1776	1981	1908
2. Pulses	"	39	36	32	31
3. Oil seeds	"	53	55	62	70
4. Sugarcane	"	117	161	123	113
5. Potato	"	130	94	111	131
6. Jute & Mesta (thousand bales)		786	1085	961	1174

Crop Yields :

1.4 Partly because of the ravages of climate and partly because of the inadequate and uncoordinated inputs, the yield of important crops per hectare has failed to increase steadily or at a fast rate as is clear from the table 1.5

TABLE : 1.5

Growth of Agricultural Productivity in Assam & India

Crops	ASSAM Average Yield 1951-54	ASSAM Average Yield 1969-72	ASSAM Annual Compound growth rate of productivity	INDIA Average Yield 1951-54	INDIA Average Yield 1969-72	INDIA Annual compound growth rate of productivity
1	2	3	4	5	6	7
Rice	975	974	0.0	793	1111.7	1.2
Jute	1263	1438	0.1	1113	1253	0.2
Sugar* Cane in terms of Gur	3345	4066	1.6**	3105	4944	1.2
Rape and Mustard	405	417(-)	0.2	396	495	1.4
Potato	5168	4181(-)	1.4	7432	8885	0.6

Note :- Yield rate in Kg per hectare.

* Average yield during 1957-60 has been quoted as estimated yeild rates for earlier years were based on eye estimates.

** Growth rate during 1957-60 to 1969-72.

without more effective control of floods and provision of irrigation, it is notlikely that production can be significantly built up.

Per capita Productivity Trend in Agriculture :

1.5 The per capita productivity per agricultural worker has declined as brought out by the table 1.6

TABLE: 1.6

Agricultural Productivity Trends in Assam at 1948-49 Prices

	1951-54 (average)	1961-64 (average)	1969-70 (average)
1. State Income from Agriculture excluding tea cultivation animal husbandry, fisheries, forestry etc. (Rs. crores)	110.2	111.0	135.7
2. Agricultural Workers(000)	2166	3284	3820*
3. Product per Worker (Rupees)	508.77	338.00	355.27

* Number of female workers in 1971 census are adjusted by using the male-female ratio among workers of 196_ census.

Looking at the position in another way, if we take the productivity per worker in 1951-54 (average) at 1948-49 prices, as the standard productivity per worker, we find that the production (that is income) generated in the agriculture sector proper in the year 1969-72 (average) would have notionally called for 5 lakhs additional workers in agriculture whereas the actual increase was 16.5 lakhs. This reflects the extent of aggravation of the under-employment situation in the rural areas of the State over the two decades 1951-72.

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II

2.0 In the process of changing circumstances in rural areas, the evolution of rights on land such as ownership, tenancy, land-holding structure etc. need to be viewed from a different angle in the context of the strategy for agricultural development. It is very necessary to know the structural and tenurial impact or operational holdings for formulating and implementing the agricultural development programme with adoption of new farm technology particularly that relating to small and marginal farmers. Today defects in land tenure and land-ownership patterns in rural areas are receiving increasing recognision at the national level with the aim of inducing agricultural development and raising agricultural productivity. Land reform is by no means the only recondition for agricultural development. But the adoption of improved technology and its concomitants of investment cannot be widely diffused unless there is equitable land distribution and economic, social and political stability with social justice. Since land ownership and its structural pattern is the central pillar of wealth, power, social privilege, and hence deeply related with political, social as well as economic life it is not free from vested interests and the power struggle. This adds a new and non-economic dimension to the problem.

2.1 The situation is grave in a setting of inadequate rural agricultural infrastructure with an expanding population. Although the necessary data in this aspect is scanty and not adequately available for a large number of years, an attempt has been made to study the problem on the basis of the latest available official data for Assam.

2.2 The distribution of operational land holdings and area operated by farm-size classes for the year 1970-71 is given in table 2.1 below. It is evident from the table that most of the operational holdings are concentrated in the small size class (i.e. up to 2 hectares). Column 5 of the Table gives the average operational area per holding by size-class. The table clearly reveals the disparity or inequality in land holdings where farm area varies from 0.45 hectare to 23.69 hectares with an over-all average of 1.47 hectares per operational holdings.

TABLE 2.1

Number of operational holdings and area operated by size class and the average operational area per holdings (1970-71)

Size classes (in hectares)	Total holdings		Average area per holding
	No.	Area	
Below 1.0	11,20,405	5,09,297	0'45
1.0 2.0	4,66,691	6,61,527	1'42
2.0 3.0	1,89,089	4,59,399	2'43
3.0 5.0	1,30,231	4,90,917	3'77
5.0 10.0	50,384	3,27,236	6'49
1000 30.0	6,555	90,245	13'77
30. & above	1,021	3,43,948	33'69
Total :	19,64,376	28,82,569	1'47

Source : World Agricultural census, Assam - 1970-71.

2.3 It would be worthwhile to examine some of the significant aspects relating to changes of the structural composition of land holding and the area operated by them by farm-size classes. For the purpose of such a comparison adequate data is not available. However the 16th Round of NSS (1960-61) and the World Agricultural Census 1970-71 do provide some information in this regard. Table 2.2 below gives the percentage distribution of operational holdings and area operated by farm size classes for the years 1960-61 and 1970-71. It will be seen from table that the marginal and small farmers (i.e. up to 2 hectares) constituted 74.1 percent of land holders and covered 43.5 percent of the area in 1960-61. In 1970-71, 80.8 percent of land holders in the same farm size group covered 40.6 percent of area. Simi-

larly, in other size groups also there are changes which seem to indicate growing inequalities.

TABLE : 2.2

Percentage distribution of operational holdings and area operated by farm size classes.

Size Classes (in hectares)	1960-61		1970-71	
	Percentage of holdings to total holdings	Percentage of area to total area	Percentage of holdings to total holdings	Percentage of atea to total area
1	2	3	4	5
Below 1.0	40.7	13.2	57.0	17.7
1.0 - 2.0	33.4	30.3	23.8	22.9
2.0 - 3.0	14.0	21.0	9.6	15.9
3.0 - 5.0	8.2	18.9	6.6	17.0
5.0 -10.0	3.4	13.3	2.6	11.3
10.0 -30.0	0.3	3.0	0.3	3.3
30.0 & above	-	-	0.1	11.0

Source: NSS 16th Round (1960-61), Report on Land Holding as obtained from the Department of Economics and Statistics, Government of Assam and for 1970-71, World Agricultural Census, Assam.

The data also reveals that during the period 1960-61 to 1970-71 there has been an increase in the number of small size holdings to a significant extent but the operational area has not proportionately increased. Considering land holding class above 2 hectares as the medium and large farmers, it would be seen that the proportion of land area occupied by them is much higher. An upward shift from lower to higher groups is evident. The same situation holds true in case of cultivating land holders in the various farm size classes. However, in contrast, in the highest size group a few holdings have appeared in 1970-71 with a considerable extent of area although that was not shown in 1960-61. This indicates land grabbing by the richer section of the people in the rural areas.

2.4. An attempt has also been made to work out the ratios of per cent of land holdings to percent of area by farm size classes for the year 1960-61 and 1970-71 and this is indicated in Table 2.3. This tends to indicate the extent of changing concentration in the pattern of land holdings in Assam during the decade.

Table 2.3

Ratios of Operational Holdings to Net Area Sown by Farm Size Classes

Size classes (in hectares)	1960-61	1970-71
Below 1.0Ø	3.09	3.22
1.0 - 2.0	1.10	1.04
2.0 - 3.0	0.67	0.60
3.0 - 5.0	0.44	0.39
5.0 -10.0	0.26	0.23
10.0 -30.0	0.10	0.09
30.0 and above	-	0.08

Note: The ratios are worked out by dividing the percent of operational landholdings by the percent of area in each farm-size class.

2.5. The number of operational holdings have also been classified into three groups according to tenurial status and the extent and magnitude of operational holdings and area by farm size classes worked out. The following table gives the percentage of owned holdings, partly owned and partly rented and wholly rented holdings and area by farm size classes for the year 1970-71.

Table 2.4

Percentage of Holdings According to Tenure Status by Farm Size Class

Size class (in hectare)	Entirely Rented		Partly Owned & Partly Rented		Wholly Rented	
	Holding	Area	Holding	Area	Holding	Area
1	2	3	4	5	6	7
Below 1.0	78.14	77.85	3.76	4.15	18.09	17.99
1.0 - 2.0	74.41	74.24	10.00	11.42	14.60	14.34
2.0 - 3.0	72.01	71.95	17.28	17.45	10.71	10.60
3.0 - 5.0	69.85	69.80	22.22	22.85	7.38	7.34
5.0 -10.0	66.43	66.15	27.85	28.17	5.72	5.68
10.0 -30.0	61.65	61.72	25.00	24.78	13.25	13.50
30.0 and above	62.30	61.15	16.20	20.03	21.44	18.82

1	2	3	4	5	6	7
Total	75.90	71.39	8.53	17.93	15.57	10.68

Source: World Agricultural Census, 1970-71, Assam.

The above data reveals that only 75.90 per cent of holdings had owned land occupying 71.39 per cent of total operated area and 8.53 per cent of holdings are under mixed tenancy system (i.e. with partly owned and partly rented land) occupying 17.93 per cent of area in the rest 15.57 per cent of holdings are under pure tenancy system covering 10.68 per cent of area. The proportion of owned holdings in lower farm size classes is interestingly higher.

2.6. The changing pattern of land holding status andthe extent of area operated by them during the period can be seen from a comparison of the 1961 census figures of land holding with 1970-71 as shown in Table 2.5.

Table 2.5

Percentage Distribution of Holdings and Area by Ownership and Tenurial Rights

Particulars	1961 Census		1970-71	
	Holdings	Area	Holdings	Area
1	2	3	4	5
1. Entirely owned	62.91	65.37	75.90	71.39
2. Partly owned and partly rented	21.70	25.27	8.53	17.93
3. Wholly rented	15.39	9.36	15.57	10.68
Total	100.00	100.00	100.00	100.00

Source: For columns 2 and 3, Census of India, 1961 and for columns 4 and 5 World Agricultural Census 1970-71, Assam.

As revealed by the table, there is a greater shift from mixed tenancy to owner cultivators group. However, the land area has not increased proportionately with the increase of landholders.

2.7 Another way of looking at the problem would be to determine the average farm area by land holding status as shown in

Table 2.6

Average Size of Holding in Rural Assam
by Landholding Status

(in hectares)

Types of holdings	1961	1970-71
1	2	3
1. All cultivating holdings	1.92	1.47
2. Owned Holdings	1.99	1.38
3. Pure tenancy (with rented land only)	1.17	1.01
4. Mixed Tenancy (partly owned partly rented)	2.24	0.69

Sources: Census of India, 1961, the relevant data for the year 1970-71 worked out on the basis of the data available in the World Agricultural Census, Assam, 1970-71.

It will be seen that the average size of farm holdings in Assam was 1.92 hectares in 1961 and this figure has recorded decrease to 1.47 hectares in 1970-71. In 1961 the average size of mixed-tenancy holdings was the highest and there has been a sharp decline in the average farm area under mixed tenancy system during the decade. Consequently ✓ in case of owned holdings and pure tenancy systems also the average size of holdings has declined to a significant extent. This decrease of average farm holdings during the period 1961-71 may be due to increase in the number of holdings because of inheritory rights on landed property.

Some Recent Measures

2.8 The total geographical area of the State is 78,523 sq. k.ms. The plains districts comprice an area of 63,301 sq.kms. and the two hills districts comprise an area of 15,222 sq.kms. The allotment occupation of use of land, other than any land which is a reserved forest, in the two hills districts is regulated by the District Councils under the Sixth Schedule to the Constitution of India. In the rest of the State, uniform pattern of land laws is applicable after the abolition of Zamindari in the erstwhile permanently settled areas. The Assam Land and Revenue Regulation, 1886 regulates and governs the terms and conditions under which Government lands are

settled in the plains districts. Settlement in the temporary settled areas of the State was made on Raiyatwaribasis, i.e. directly with the occupants under the land settlement policy till 1972. The land settlement policy was changed in 1972 and it was decided that the settlement of Government agricultural lands for ordinary cultivation will henceforward be not given on individual basis, cooperation basis etc. It was decided that land available for cultivation will be amalgamated and allotted to corporations formed of my eligible landless cultivators of the village concerned. These corporations have been set up to:

a. concretise the concept that land is a means of livelihood and not property;
b. evolve the concept of participative management in which the people manage and direct their own affairs;
c. ensure that the most modern and economic technology is adopted by the participants;
d. provide all modern inputs like improved seeds,, fertilisers, farm machinery and a common facilities like threshers and warehouses to the participants;
e. raise the qualify of life by providing a common welfare complex in which housing schools, health care and recreational facilities are provided.

2.9 The facilities available in these corporations are:

a. the provision of 9 bighas of land to each participating family, of which 8 bighas would be for cultivation and one bigha for homestead;

b. the rehabilitation of the participating families in a planned manner with proper housing facilities which could lead to the upliftment of the quality of their life;

c. the working out of cropping pattern for each farm, so as to lead to the optimum utilisation of land, taking into account its soil and physical characteristics as well as the aptitudes of the concerned family;

d. the designing of a community welfare complex which would enable the provision of educational facilties, health care centres, a veterinary centre, playground, common recreation hall, roads, a marketing centre, ware housing facilities, an agro-custom centre as well

as an agro-processing centre, if necessary. The community complex should not only be properly designed and planned, but should also, as far as practicable, be provided by the Corporation from within its own funds or through institutional finance;

e. the saturation of the area with irrigation facilities so that every inch of land is covered with irrigation;

f. the provision of improved and tested seeds, the needed fertilizers, tractorisation and all other inputs;

Land Reforms Measures

2.10 The Assam Fixation of Ceiling on Land Holdings Act, 1956 came into force with effect from 15th February, 1958. The act was not ordinarily applicable to tea-gardens. Therefore it was amended in 1970 whereby lands from tea-gardens could also be acquired. The ceiling act was further amended bringing down the ceiling to 50 bighas for individual holdings. The act came into force with effect from 17th September, 1975. A crash programme for acquisition of land under the ceiling laws was undertaken by the Government in various districts of the State. The position regarding acquisition and distribution till 31.7.76 is given at annexure I. This process of acquisition of land under ceiling laws and distribution of surplus land to the landless will change the pattern of land holdings in the State. Even though the number of landless will come down, it is apprehended that there would be not much impact on the removal of the imbalances at present prevailing in the land holding system since in many cases only existing financing would be converted to ownership.

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III

THE POTENTIAL FOR PRODUCTION

A. Background

2.1 The most important foodgrains in Assam is rice. In 1974-75 it constituted about 20% of the total area under annual crops in the state, 92% of the food-grain area and contributed 94% of foodgrain tonnage; area figures for the main annual crops

are given in table 3.1.

TABLE : 3.1

Area figure for the main annual crops

Crop	Area ('000ha)
Rice	2,058
Wheat	61
Coarse grains	26
Pulses	97
Oilseeds	183
Jute	120
Sugarcane	42
Potato	26

Source : Dept. of Economics and Statistics.

Rice production is almost totally confined to the plains, which consist of a strip approximately 850 Km. by 60 to 120 Km. along the Brahmaputra Valley and an area of about 80 X 60 km. in Cachar District, lying in the south of the state and separated from the Brahmaputra Valley by the Cachar Hills. Almost the whole foodgrain area is rainfed, only an estimated 5% (150,000 ha) being irrigated.

3.2 The summer rainfall and temperatures in the plains of Assam are particularly favourable for the rainfed production of rice, in contract to much of India. Two rainfed rice crops are theoretically possible. Due to humid and relatively cool conditions during winter, residual moisture is only slowly depleted so that rabi crops of wheat and pulses can be grown; rabi rice is also possible, provided supplementary irrigation is available and cold-tolerant varieties are used.

3.3 The soils of the plains areas are alluvial and, especially in the flood-prone areas which receive annual deposits of silt, are relatively fertile. The new alluvial soils, which cover the greater part of the Brahmaputra Valley, are predominantly sandy or loamy soils or neutral reaction having moderate levels of available phosphorous and potash. They can be worked with draught animals even in the dry season. The elder alluvial soils on the south side of the valley and in upper Assam are somewhat acidic, poorer in available phosphorus and, having a heavier texture, they cannot be ploughed when dry using the local draught animals. The mountain valley alluvial soils of Cachar district are more acidic than the other two groups, intermediate in texture and have a nutrient status

similar to the old alluvial soils. There are no significant problems of salinity, and drainage is generally adequate except in limited low-living areas. Extensive reserves and good quality groundwater exist below much of the plains areas, often at a depth of less than 5 metres.

3.4. Despite protection works, flooding remains a feature of the Brahmaputra Valley during the peak monsoon period from mid June to mid-August. The area of crops damaged varies widely but has averaged above 200,000 ha over the last six years and it is estimated that some 400,000 ha of land area are at risk from flooding each year.

3.5. As already mentioned the average size of operational holding in Assam is less than 1.5 ha and 90% of the farmers, operating 56% of the land, have holdings of less than 3 hectares. It is estimated that some 30% of cultivators, operating about 20% of the land, are share-croppers. Despite recent laws which limit the landlord's share to 25% or less, the traditional 50% of produce is still given in most cases.

B. Present Practices and Production Cropping Seasons, rotations and itensity

3.6. There are three rice growing seasons in Assam. The main rice crop, known as sali, is transplanted in July-August and harvested in November or December. It receives the full monsoon rain. Second in importance is the ahu crop, which is traditionally direct seeded at the onset of pre-monsoon showers in March or April and harvested in June or July. The rabi rice crop, known as boro, is of only minor importance; it is transplanted into low-lying areas from January to March, harvested in May, and usually receives some irrigation by traditional methods. The timings of the three crops therefore overlap and in practice farmers tend to concentrate on the sali crop because its water supply is more assured. On flood-prone land sali rice is planted in September on the receding flood.

3.7. Wheat, pulses and coarse grains are grown on residual moisture as rabi crops. They are sown in November, December or January after harvest of sali rice. The present traditional sali varieties mature rather too late to allow rabi crops to be planted at the optimum time. If grown, rabi crops may therefore suffer water stress which limits yield or can cause total failure. For wheat, delayed planting results in harvest during the pre-monsoon showers of April. Nevertheless the wheat area has increased from a few hundred hectares ten years ago to 61,000 ha, at the expense of traditional rabi crops such as

rape and mustard. Among the pulses there is a recent move from grams and lentils, which require September planting, towards peas, which can be planted as late as December and outyield the traditional pulses.

3.8. The other major annual crops of Assam are oilseeds and Jute. Jute is sown in April and harvested in July and therefore cannot readily be accommodated in rotation with ahu rice or rabi wheat. Oilseeds are grown in the rabi.

3.9. Despite the many possible cropping patterns available the state average cropping intensity is only 125%. The present intensity of foodgrain cropping is estimated at 70% on the flood-prone areas, and about 105% on areas which are not flooded.

Standards of husbandry

3.10. Crop husbandry practices are generally traditional. Land is prepared by time-consuming methods using numerous shallow passes of the traditional plough, alternating with laddering. For dry-sow crops clods may be broken by hand, using long-handled mallets. Incorporation of perennial weeds is poor and land levelling for paddy and irrigated crops is uneven. Rainfed fields are only lightly bunded. No drainage channels are provided for rainfed or irrigated fields and the efficiency of water utilization on irrigated areas appears to be low.

3.11. Direct-speeded ahu paddy, wheat and pulses are almost universally broadcast. Annual weeds are very numerous in these crops and, due to the incidence of water stress, are potentially highly damaging. Since the crops are not line-sown, control measures are confined to cross-harrowing of ahy paddy (which severely disturbs the crop as well as the weeds) and infrequent hand pulling of weeds in the other crops. Yield losses due to weed competition are therefore considerable, and for high-hielding rice varieties, which are shorter statured and less tolerant of harrowing, potential losses are even greater. For transplanted paddy the planting points are often too widely spaced and too many seedlings are planted per hole. Yields may therefore be limited by sub-optimal plant populations and weeds are again given ample opportunity to compete.

3.12 Harvesting, threashing and storage practices are also traditional. The climate of Assam poses special problems for the ahu paddy crop which comes to harvest at the height of the monsoon and to a lesser extent for wheat. Damp and cloudy conditions may make it impossible to dry these crops to a level

where they can be safely stored. Spoilage is therefore frequent. Saved seed often shows poor germination for the same reason.

3.13. Except in the sali season (when almost all farmers have a crop on the ground) grazing livestock are often permitted to wander during the day with consequent damage to standing crops.

Draught power, implements and input use

3.14. The local bullocks are small and capable of a sustained draught of only some 35 kg. per pair. Bullock-drawn or hand-operated row seeders are virtually unknown, there is only one tractor per 55,00 hectares of cropping. Powered sprayors and threshers are even less numerous.

3.15. Use of purchased inputs is of the same low order. Fertiliser use on foodgrains in 1974-75 is estimated at only some 4,500 tons nutrients (an average of about 2 Kg/ha). Only about 20% of rice is under improved local or highyielding varieties. Seed sales in 1974-75 totalled about 5,000 tons and most.saved seeds is sown without fungicide dressing. Use of other pesticides is also rare. Institutional production credit totalled only 4,000 loans in 1974-75. The case resources available to finance production appear for the average farmer to be very slender.

Yields and production

3.16. Foodgrain yields in Assam are summarized in table 3.2. They are among the lowest in India and have shown little increase over the last five years.

TABLE : 3.2.

Foodgrain yields, tons/ha

Crop	1970-71	1971-72	1972-73	1973-74	1974-75
Rice /a	1.05	0.99	1.07	1.01	0.98
Wheat	0.58	1.20	1.43	1.15	1.26
Maize	0.55	0.55	0.55	0.55	0.54
Other cereals	0.50	0.49	0.50	0.50	0.51
Gram	0.54	0.55	0.49	0.49	0.49
Tur	0.71	0.71	0.71	0.91	0.40
Other pulses	0.36	0.34	0.48	0.46	0.39

/a as clean rice

Source : Dept. of Economics and Statistics

3.17 Since the areas under foodgrains have increased only slightly during the same period, total production also shows little change (Table 3.3)

TABLE : 3.3

Total foodgrains production ('000 tons)

Crop	1970-71	1971-72	1972-73	1973-74	1974-75
Rice /a	1,980	1,908	2,177	2,066	1,984
Wheat	12	48	160	48	78
Maize	7	6	6	8	8
Other cereals	3	3	5	4	5
Pulses	32	31	48	45	40
Total	2,034	1,996	2,396	2,171	2,115

/a as clean rice

Source : Dept. of Economics and Statistics

3.18. The relative yields, areas and production derived from the three rice crops in 1974-75 are given in table 3.4.

TABLE : 3.4

Yield, area and production, 1974-75

Crop	Area ('000 ha)	Yield /a (tons/ha)	Total production /a ('000 tons)
Ahu (pre-monsoon)	587	0.71	397
Sali	1,431	1.09	1,540
Boro(rabi season)	40	1.21	47
Total	2,058	-	1,984

/a as clean rice

Source : Dept. of Economics and Statistics

C. Production Potential and Constraints

3.19. There are three ways in which foodgrain production might be increased; by increasing the area under cultivation, by raising crop yields or by raising cropping intensity.

Increasing area under cultivation

3.20. There is little scope for bringing new land under food-grain cultivation. Although only 28% of the geographical areas devoted to annual cropping, most of the remainder is either unsuitable due to slope or rockiness (33%), already under perennial crops such as ten (2%) or scheduled as forest reserves (27%) only some 180,000 ha (2%) are classified as cultivable waste. Even if all this could be brought under cultivation it would add only 8% to the present area available for annual cropping.

Increasing crop yields

3.21. There is ample scope for increasing crop yields with the application of improved agricultural practices, high yielding varieties and higher use of fertilizers.

Increasing cropping intensity

3.22. The theoretical scope for raising cropping intensity is considerable. Since most farmers take a full sali rice crop, to increase cropping intensity in practice means growing larger areas of ahy rice and/or rabi crops. There are practical possibilities of triple rainfed cropping by small farmers with double cropping on the flood-prone areas.

3.23. Increased rabi cropping intensity, since it relies on residual moisture, does not require soil to be ploughed when dry and it is easier for the farmer to assess the risk of subsequent water shortage. However, plantating of rabi crops needs to be earlier than at present if establishment and yields are to be more reliable, which in turn imposes a need for quicker land preparation or, preferably, an earlier sali harvest.

The role of irrigation

3.24. Considerable emphasis has been laid in the past on increasing the extent of irrigation in Assam. Irrigation can facilitate land preparation by softening the heavier soils and can eliminate the risks to pre-monsoon and rabi crops. It can thus contribute to the attainment of both potential yield and cropping intensity and is particularly applicable to the floodprone areas, where the requirement to avoid cropping at the height of the monsoon pushes the available cropping

periods either earlier into the pre-monsoon season or later into the rabi. So irrigation development merits the highest priority and cheap methods of supplementary irrigation need to be devised. High priority has to be given to the development of hand or animal-powered systems for raising ground-water, Their cost should be within the resources of the smaller farmers unlike existing mechanically-powered shallow tubewells the smallest of which irrigate an area equivalent to three average-sized Assamese holdings.

3.25. The installation of full-scale irrigation facilities is less easy to justify on the grounds of water requirements alone. But there would be additional yield gains from the sali rice crop from the controlled drainage with which such irrigation would presumably be associated.

Cause of low production

3.26. These may be grouped under five headinds.

(i) Constraints over which the farmer has no direct control. These include flooding, which compels him to plant at times of increased drought risk. Variability of rainfall, especially of pre-monsoon showers, is a further constraint to rainfed yields.

(ii) Bad husbandry practices. These include inadequate weed control, incorrect crop spacing, incorrect timing of operations to take advantage of favourable conditions, insufficient organic manuring and failure to exclude grazing animals from crops.

(iii) Inadequate draught power and implements. Slow land preparation given by the present combination of poor draught animals with traditional implements both limits cropping intensity and delays the time of crop planting.

(iv) Non-adoption of modern inputs. High-yielding or local improved varities, fertilizers and pesticides have generally been promoted in the past as a complete package. Few farmers have been prepared to risk borrowing the cash and fewer still can provide it from their own resources.

(v) Institutional factors. The principal institutional - related constraint in the past has been the failure of extension to raise basic husbandry standards to

the point where farmers could obtain reliable results for modern inputs. In addition the institutions concerned with input supply and seasonal credit are not particularly effective. Finally there is the possible influence of sharecropping. Some 20% of land appears to be share-cropped thereby leading to the danger of sharecropped land being neglected at the expense of owned land.

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IV

STRATEGY OF DEVELOPMENT

4.1. The development strategy for agriculture should basically aim at harnessing the development potential to the optimum extent possible by adopting measures which can have the greatest impact on production by removing the constraints to increased production. This calls for envolving a suitable technology, patricularly for smaller farmers, easy availability of credit, proper utilisation of ground water by spreading the benefits to small farms, evaluation of a technology suitable to flood prone areas, land reforms, and adequate provision for research and extension.

Strategy for smaller farmers:

4.2. In Assam 90% of holdings are less than 3 hectares in size and 80% are less than 2 hectares. Thus to a great extent the strategy for agricultural development in Assam must be a strategy to increase productivity of the small farmer. Most of the farmers in Assam are still at a traditional level of operation and have little or no experience of modern input services. The development strategy should, therefore, to start with, take into consideration the needs and capabilities of the typical farmers and carefully introduce the farmers to modern methods. This means that in the early years the farmers may adopt simple but improved cultural practices which could substantially increase production thereby laying the basis for the successful introduction of modern inputs without any major change in production techniques or significant risk to the farmers.

4.3. Many of the big farmers are already using advanced farm techniques, have more resources to invest in their land and have better access to credit and input supplies. This group of larger farmers, as well as the more enterprising smaller farmers, certainly will be able to take advantage of modern tech-

nology much sooner than the majority of farmers and should be encouraged to do so.

4.4. About one-third of the farms consist of areas less than half hectare. These very small farmers together with the landless labourers cannot produce marketable surplus in their farms so as to be able to purchase modern inputs. These unfortunate families will have to rely on non-farm employment or much more land-intensive activities to generate income. They need to adopt improved cultural practices, which do not involve any significant cash expenditure, and have access to credit at reasonable rates.

4.5. The distribution of land holding in Assam is shown in table 4.1.

TABLE : 4.1.

Distribution of land holding

of holding in hectare	% of holding	% of cultivated land
Below - 0.5	33	6
0.5 - 1.0	24	12
1.0 - 2.0	24	24
2.0 - 3.0	10	17
3.0 - 5.0	7	18
Over - 5.0	2	23
	100	100

The patterns of land ownership suggest the urgent need for land redistribution since land is basis for the livelihood of the rural masses. Land reforms and land re-distribution are necessary not only for attainment of the objectives of social justice but also for promoting the overall growth of production in agriculture. Therefore, land reform measures need to be implemented as a part of the strategy of agricultural development and not needs directed towards structural change in the rural society.

Ground water development

4.6. For ground water development, the major requirements are to promote cheaper focus of irrigation facilities and to provide an adequate and integrated extension service. The orthodox shallow tubewells and pump is suitable for only the largest 15% of farmers. These larger farmers hold about half the land.

Thus there is a clear need to spread the benefits of ground water to small farms on ground of both efficiency and equity. Therefore, development of smaller and cheaper tubewells and pumps which will be within the reach of small operators for sharing water need to be evolved.

Technology for flood prone areas:

4.7. In Assam, a large percentage of cultivated area is inundated in the monsoon season. These flood prone areas have to adopt cropping patterns designed to avoid period of peak risks, thus the strategy should be flood avoidance and risk minimisation. For flood prone areas, a suitable cropping pattern needs to be introduced, the emphasis being given to rabi and quick maturing crops which can be harvested before the onset of the monsoon.

Credit :

4.8. The existing institutional credit structure in Assam is weak and the use of agricultural credit is negligible. Institutional credit for agriculture is provided by Co-operative Credit Institution and Commercial Banks. The Co-operative Credit structure has two wings, one providing short and medium term credit, the other long term credit. Commercial Banks are relatively new entrants in the field of agricultural financing. There are 663 Gaon Panchayat level Co-operative Societies. The problems regarding agricultural credit mainly, are -

a. credit flow is very low. During 1975 Kharif season only about 4000 cultivators received short-term credit amounting to rupees ten lakhs only. Longterm credit disbursed through the Assam Co-Operative Land Mortgage Bank in 1975-76; was Rs.17 lakhs only;

b. high level of overdues due to non-repayment;

c. unsound loans; and

d. in-efficiency of credit institutions.

In the above background, the strategy for channelising credit to the rural areas should be :

a. strengthening of the new Gaon Panchayat level credit societies for operation in short-term credit;

b. removal of the constraints of operation of the commercial banks;

c. determined campaign to recover overdues; and

d. arrangement of term lending for tube wells and other irrigation facilities through commercial banks.

Research :

4.9. Technical research and development targetted specifically at the potential and the problems of the weaker sections should be undertaken. This must have special relevance to the small and marginal farmers. This would include :

a. adaptive research and extension to promote low-cost, low risk improved practices which are particularly suitable for the smallest farmers;

b. development of small and low cost ground water facilities;

c. research on modernisation of farm implements;

d. simplified and more flexible credit procedures;

e. identification of ways to increase the income and consumption levels of the landless and submarginal farmers who do not have enough land to break out of their subsistence economy.

Mass contact :

4.10. Alongwith the development of small farm technology, technology for flood prone areas and the spreading of credit facilities, a quick and efficient mechanisam needs to be created for transferring technological knowledge to the masses. There also need to be an appropriate incentive system which motivates the farmers to adopt new techniques.

Extension :

4.11. In order to bridge the gap between the potential and actual production, re-organisation of agricultural extension facilities needs to be done so as to reflect the level of skills of farmers and the resource available to them. The majority of Assamese farmers are not very skilled; they may have an excess of family labour but have very little cash to invest in production. Hence extension in Assam should concent-

rate initially on the improvement of basic husbandry standards, principally by more effective use of family labour. Modern inputs should only be recommended later, when skills have reached a level sufficient to benefit from them, and then only at levels which the farmer can afford. Pending resolution of the uncertainties surrounding the effectiveness of low doses of fertiliser under Assam conditions, the first modern inputs to be emphasized could to HYVs and seed treatment, with higher doses of fertiliser being promoted later.

Rural Development Agency

4.12. In addition the strategy has to be such as to provide additional employment facilities in the Rural Sector. Partly this could be provided by modernisation of Agriculture. But as discussed this is likely to be a somewhat lengthy process. An experiment has been carried on in Assam recently by setting up a Rural Development Agency. The main features of the Agency's approach are :

a. it concentrates on the bottom 20% of the population (both urban and rural);

b. first priority is given to identifying the needs and capabilities of the target groups through socio-economic surveys at the village level;

c. its emphasis is on identifying commercially viable investment opportunities for the poor which can be financed through commercial banks without government subsidies:

d. prototype "model schemes" are developed and costed for replication throughout the State;

e. importance is attached to proper evaluation and control.

The Agency has been able to develop over 64 prototype "model schemes" (Details of which are given in the Annexure-II) As may be seen, the loan-incremental income ratio is extremely favourable and there is enough potential in the rural areas for generating incomes and employment through the above approach. An integrated package of Agricultural Development and non-agricultural activities of the types identified by the Rural Development Agency may, perhaps, be the answer to employment and income development in the rural sector.

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Annexure - I

Land acquired & distributed under land Ceiling Act as on 31.7.1976

(Area in thousand bigha)

District	Area of Ceiling Surplus land acquired	Distribution of acquired ceiling surplus land.	
		No. of Families	Area distribution
1. Goalpara	103.0	5510	24.0
2. Kamrup	226.0	23931	79.0
3. Darrang	288.0	58715	237.0
4. Lakhimpur	24.0	4240	19.0
5. Dibrugarh	234.0	21018	78.0
6. Sibsagar	307.0	43125	149.0
7. Nowgong	44.0	3640	16.0
8. Cachar	342.0	41974	105.0
Total	1568.0	202153	707.0

Annexure - II

List of Model Schemes

(A) Cottage and Village Industries

1. Basket Making
2. Bee Keeping
3. Black Smithy
4. Broom Manufacturing
5. Cane and Bamboo work
6. Carpentry
7. Cobbler
8. Country loom with Eri
9. Eri yarn spinning
10. Fish net making
11. Japi making
12. Leather Tanning
13. Pati (mat) Making
14. Pottery
15. Production of Laichampi
16. Spinning through Amber charkha
17. Tailoring
18. Tin Smithy
19. Weaving
20. Weaving with cotton mixed eri yarn
21. Brick manufacturing
22. Rope making unit
23. Quilt making

(B) Homstead Agriculture:

1. Cultivation of Pineapple
2. Cultivation of Turmeric on one bigha of land
3. Ginger Cultivation on one bigha of land
4. Eri cultivation on two bigha of land
5. Kitchen garden
6. Mulberry Plantation

(C) Petty trade and Commerce

1. Arecanut vendor
2. Betlemut vendor
3. Chana and Pakouri stall
4. Chat House
5. Chira and muri business
6. Coconut vendor
7. Firewood depot
8. Fish vendor
9. Fruit vendor
10. Grocery shop
11. Hair cutting saloon

12. Kerosene vendor
13. Pan cum stationery shop
14. Processing and sale of dry fish
15. Ready made garments
16. Rice (hand pounded) sale shop in the local market
17. Tea stall
18. Umbrella repairing
19. Vegetable vendor
20. Cloth business
21. Egg dealer
22. Bakery
23. Furniture making.

(D) Transport
1. Boat plying
2. Buffalo cart with a pair of animal
3. Bullock with cart
4. Cycle repairing
5. Hand driven cart (thela)
6. Ricksaw pulling

(E) Veterinary and Pisciculture

1. Duck keeping
2. Goat keeping
3. Pig rearing
4. Small Diary unit
5. Small fisherman
6. Poultry

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AGRICULTURAL DEVELOPMENT IN U.P. : 1950-51 TO 1972-73

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I. Introduction

Both in the history and theory of economic development the role of agriculture has been identified as the critical factor. Agricultural development depends on natural factors, tenurial system and technological advancement. Since the administrative units have become bases for planned and non-planned economic development, we have assumed them to be regions and sub-regions for the study. Thus Uttar Pradesh is our region : and the agro-economic-cum-administrative districts have been suitably combined to form the sub-regions. So far the natural factors are concerned we have not gone into geographical details but confined ourselves to broad indicators like rainfall, moisture index and types of soil. We believe that to a great extent these factors can be modified by irrigation facilities and water management. So far the tenurial system is concerned, Zamindari was abolished in U.P. in 1951 and gradually peasant proprietorship has become the predominant system. There have been slow and uneven growth of agricultural technology in the state; and surely there are marked sub-regional variations.

II. Land Utilization

Any discussion on agricultural development should start with an assessment of land utilisation. During the last two decades the land utilisation in U.P. has remained almost constant, as the increase is only 1 per cent. There are, however, significant sub-regional differences, varying between 3 per cent in Eastern and 1.2 per cent in Central regions. There is a decline of 5.5 per cent in the case of Hill region. At this stage the respective shares of the different sub-regions in the total area of land utilised may be given : Eastern region 34 per cent; Western region 33 per cent; Central region 18 per cent; Bundelkhand region 12 per cent and the Hill region 3 per cent. Therefore, from the viewpoint of growth Eastern and Western regions deserve

the utmost attention; while from the viewpoint of welfare the other regions; although the two criteria are interdependent.

During 1950-51 to 1972-73 the barren and uncultivable waste has been reduced from 6 per cent to about 4 per cent of the total area under land utilisation. Region-wise decline in barren and cultivable waste is the sharpest in the Hill sub-region, being 78 per cent, followed by Bundelkhand, 31 per cent. This shows a general trend in better utilisation of land resource, especially in the Hilly and Rocky sub-regions. This trend for U.P. is more true for the land falling under the category 'Cultivable Waste' (the total being 2.3 million hectares) as about half of it has been brought under cultivation during the period under study. As a continuation of this trend even permanent pastures and other types of grazing land has been reduced in the State from 0.4 per cent to 0.3 per cent. Certainly this is not a desirable practice. The current fallow has registered a decline from 4 per cent to 3.5 per cent. This is also true for the area under 'Miscellaneous Tree Crops and Groves' which has declined from about 5 per cent to about 2.4 per cent. This unfortunate trend is compensated by an increase in the forest area from 5.2 per cent to 8.7 per cent, showing an increase of more than 70 per cent. On the sub-regional level also there is an increase everywhere, except the Hill region which has registered a decline of about 2 per cent. The net area sown has increased from 62 per cent (15.61 million hectares) to 65.7 per cent (16.69 million hectares). There are sub-regional variations : the Hill region is the leader with its record of above 75 per cent increase whereas the Western region stands at the bottom with an increase of 2.5 per cent. No wonder, because the Western region has been a developed one and had already reached a point of maturity. It is noteworthy that the non-agricultural utilisation of land has increased by about 10 per cent in two decades. The sub-regional variations are: 21 per cent in Western region and about 15 per cent in the Hill region; and 3 to 5 per cent in the rest.

III. Size of Land Holdings

The distribution of the size of farmer's (family) operational holdings is given in Table 1. The table shows that about 75 per cent of the total area of landholdings is below 5 hectares. There are regional variations : the Central sub-region comes at the top, with more than 80 per cent, closely followed by the Eastern sub-region. We are ignoring

Table 1

Distribution of the Size of Farmers'(Family) Operational Holdings

Regions	AREA IN HECTARES							
	0- 5	5-10	10-20	20-30	30-40	40-50	50 and above	Total
Western	4597405 (74.50)	1101112 (17.84)	351718 (5.70)	54884 (0.89)	17645 (0.29)	8333 (0.14)	39612 (0.64)	6170709 (100.00)
Central	2637037 (80.44)	390310 (11.90)	175019 (5.34)	31013 (0.95)	13753 (0.42)	4570 (0.14)	26511 (0.81)	3278213 (100.00)
Bundelkhand	1008520 (48.20)	556044 (26.58)	366036 (17.49)	97306 (4.65)	33862 (1.62)	12547 (0.60)	17918 (0.86)	2092233 (100.00)
Eastern	4673774 (78.27)	752276 (12.60)	347779 (5.82)	88795 (1.49)	39800 (0.67)	19670 (0.33)	49155 (0.82)	5971249 (100.00)
Hill	382568 (96.43)	11249 (2.84)	1695 (0.43)	-	-	375 (0.09)	842 (0.21)	396729 (100.00)
U.P.	13299304 (74.25)	2810991 (15.70)	1242247 (6.94)	271998 (1.52)	105060 (0.59)	45495 (0.25)	134038 (0.75)	17909133 (100.00)

Source: Agricultural Census 1971.

the Hill sub-region as it is natural that agricultural holdings will be smaller. But worse is the picture when we analyse the number of holdings below 5 hectares. In the state 45 per cent of the holdings are below 0.5 hectares. In respect of the sub-regional orientation the Eastern region tops (about 57 per cent) followed by the Western (about 39 per cent) and the Central (about 37 per cent) regions. The figures for less than 1 hectare are about 75 per cent for the Eastern region, followed by about 70 per cent for the Central, and 58 per cent for Western regions. Without further going into this exercise one may safely state that the number of holdings below 0.5 hectares has increased after the redistribution of land, more particularly with the implementation of the 20-Point Programme. Here, it should be pointed out that after the implementation of the land ceiling, under the 20-Point Programme, the family land holdings above 7 hectares should not exist. But the data in Table 1 are obviously six year old. Even according to these data the larger the size of landholdings (with the exception of the last size of landholding, as the range has no upper bound), the smaller the number of the landholders, and the percentage of the total land area held by them.

The problem of agricultural workers is a complex one, as neither uniform definition has been used in various estimates nor such an estimate can keep pace with the proletarianization of agricultural labour.1/ But according to the Uttar Pradesh Arthik Samiksha of 1975-76 (The U.P. Economic Survey : 1975-76) the percentage of workers engaged in agriculture and allied occupations to the total workers is 40.7. The percentage of agricultural workers in the Eastern sub-region is above the state average (43.2) and in the Western below the average (37.0). With the redistribution of land to the landless the situation cannot materially change, as the plot of land allotted is small; it is too early to forecast the actual state of its cultivation in future. In one respect, however, it does make a difference : there is a minimum base for subsistence, if the plot is utilised for cultivation. It should, simultaneously, be pointed out that due to a series of legal and extra-legal devices the large holdings, by and large, continue to be operational units.

1/ Singh, V.B., 'Growth of Capital and Agricultural Labour in Uttar Pradesh : A Study of Ballia and Meerut Districts', Unpublished Report, 1975.

IV. Inputs

We have data for the following inputs : (i) irrigation (source-wise), (ii) fertilizers, (iii) pesticides, (iv) tools and machines for using pesticides, and (v) agricultural implements (man/animal operated) and machines (energy based). Unfortunately, we do not have figures for hybrid seed, but some deductions can be made about its increasing use as it is correlated with the use of water and fertilizers. 'Area under High Yielding Crops' does not throw much light on the problem in hand, except the magnitude of increase of High Yielding Crops.2/

i. Irrigation: We have four sources of irrigation : canal, tubewell, well and others.3/ The total irrigated area has increased from 4.03 million hectares during 1950-51 to 7.00 in 1972-73. Thus there is an increase of about 75 per cent. In this increase, different sources have contributed in different ratios. The important points to note are : first the area irrigated by canal was about 46 per cent of the total in the year 1950-51, which has declined to about 35 per cent of the total area in 1972-73. Second, to the contrary, 6.7 per cent of the total irrigated area was served by tubewells in 1950-51, but in 1972-73 this percentage has increased to over 37.3. Thus, the tubewell irrigation has increased by about 5.5 times. Third, the share of well-irrigated area was about 48 per cent, which has declined to about 25 per cent. Fourth, the other sources irrigated 0.3 per cent of the total irrigated area in 1950-51 which has increased to about 5 per cent in the year 1972-73. In conclusion we may say that the total irrigated area has increased in which tubewells are playing the leading role.

The breakup of the total area irrigated in the state during 1950-51 to 1972-73, on the twin criteria of distribution by region and source, gives an interesting picture. The growth of the canal irrigation during the period under review is as follows : Eastern region 314 percent, Bundelkhand 96 per cent,

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2/ During 1968-69 to 1972-73 the area under Hybrid Bajra has increased 578 per cent; exotic paddy by 221 per cent; and High-yielding wheat by 141 per cent whereas there has been a decline under Hybrid maize and Hybrid Jwar by 77 per cent and 93 per cent respectively.

3/ 'Others' include reservoirs, tanks and lakes.

Hill region 58 per cent, Central region 19 per cent and Western region 5 per cent. The late starters have a higher growth rate with the exception of the Central region; and the Western region shows a low rate because of high base. However, the growth of different sources of irrigation have to do something with natural endowment. This is why in the Hill region it is not the canal or well or tanks and lakes but tubewell that has developed the fastest. The growth of tubewell irrigation in descending order is as follows: Hill region 181.343 per cent; Central region 42.347 per cent; Eastern region 10.604 per cent; Bundelkhand 15.77 per cent and Western region 4.82 per cent. The distribution of well-irrigation is as follows: Hill region 16.9 per cent; Bundelkhand region 6.4 per cent; Eastern region 40 per cent; Western region 25 per cent and Central region 15 per cent. The growth of irrigation through lakes and tanks during the period 1953-54 to 1972-73 is as follows: Hill 38.00 per cent; Bundelkhand 4.88 per cent; Eastern 3.7 per cent; Central region 22 per cent and Western region 6 per cent.

The net area irrigated by reservoir is constantly vanishing. In the Western region, the area irrigated by reservoir has declined to one third during 1953-54 to 1966-67. Similarly, in the Central region it has come down to about one-seventh of the figure of 1953-54 to 1961-62. In the Bundelkhand it has been reduced to one eighth during 1950-51 to 1972-73 and in Eastern region during 1970-71 it was one hundred and twentieth of 1950-51 figure. In the Hill region, the reservoirs do not exist; but even in the other regions they have completely vanished in the early seventies with the exception of Bundelkhand region.

It is pertinent to point out, even in passing, that for utilising surplus labour for creating physical assets, in the economy, which will boost up production, income and employment and will have an anti-inflationary impact, the utilisation of lakes, tanks and reservoirs, old depleted or new, provide vast possibilities in the State and District Plans. This is the meaning of generating productive employment, which has rightly been emphasized in the Fifth Five Year Plan.

ii. Fertilizers: There are three types of chemical fertilizers : Nitrogen (N_2), Phosphate (P_2O_5) and Potassium (K_2O_5). The figures for the consumption of the first two are available since 1956-57 and for the third one since 1966-67 for U.P. The consumption of Nitrogen (N_2) has increased by 18 times during 1956-57 and 1972-73 while that of phosphate (P_2O_5) has increased 170 times. The consumption of potassium

(P_2O_5) has increased 24 times during 1966-67 and 1972-73. The total consumption of the three has increased by 25 times. This may be because of the low base, nevertheless the trend is unmistaken.

The regional variation of the consumption of Nitrogen, in descending order, is: Bundelkhand 167 times; Hill 54 times; Central and Eastern 18 times each and the Western 14 times. The consumption of phosphate in descending order is: Eastern 323 times; Hill and Bundelkhand 272 times; Western 182 times and Central 91 times. The consumption of Potassium is: Central 170 times; Bundelkhand 79 times; Hill 33 times and Western and Eastern 23 times each. The overall consumption in Bundelkhand is high. This seems to be correlated with the rapid increase in irrigated area.

iii. Pesticides: The high consumption of irrigation facilities and fertilizers normally leads to better use of pesticides. The available figures for the consumption of pesticides are for the whole of U.P. and not for different regions. The intensity of the consumption patterns of the various pesticides are in the following order for the period 1951-52 to 1970-71 : seed-treating chemicals has increased by 83 times; dusts 20 times and emulsions 16 times. The combined consumption of all the pesticides has increased by about 55 times—seed-treating chemicals being the leader.

As a result of increase in the consumption of pesticides the plant protection tools and machines have also increased as can be seen from Table 2.

Table 2

Availability of Plant Protection Machines(till the end of 1970-71)

Type of Machine	Number
A. POWER OPERATED	
i. Conventional type	512
ii. Low-volume type	6,515
Total	7,027

Type of Machine	Number
B. MANUALLY OPERATED	
i. Hand Dusters	10,258
ii. Foot Sprayers	8,900
iii. Rocking Sprayers	3,710
iv. Knap-sack Sprayers	1,934
v. Seed Dressers	1,377
vi. Fumigating Pumps	3,298
Total	29,477
Grand Total	36,504

Source: Plant Protection Service, U.P., Lucknow.

iv. Plant Protection Services: Consequently, the total area covered by Plant Protection Service has increased from 20.85 lakhs acres to 177.62 lakh acres during 1961-62 to 1970-71. This means an increase of more than 8 times. But in this increase the share of the area covered by the State Plant Protection Service has increased from about 4.0 lakh acres to about 29.5 lakh acres, i.e. by more than 7 times; whereas the area served by non-state agencies has increased from about 17 lakh acres to 148 lakh acres, i.e. more than 8 times. The obvious conclusion is that the plant protection services in both State and non-State sectors have not appreciably grown; and the share of the state has declined from 19 to 17 per cent; whereas that of the non-state sector has increased from 81 per cent to 83 per cent. Thus the rate of growth in the private sector has an edge over the State sector.

V. Output

Now we are in a position to assess the trends in output. This we propose to do under the following heads: (a) Total food 4/, (b) Cereals, (c) Pulses, (d) Oilseeds, and (e) Commercial crops—Jute, Cotton, Sugarcane and Potato.

4/ This group consists of Rice, Jwar, Bajra, Maize, Mandua, Sawan, Kodon, Kakun, Kutaki, Urd, Moong, Moth, Wheat, Barley, Gram, Peas, Arhar and Masoor.

(a) Total Food : During 1950-51 the total food production of U.P. was 11.8 million metric tonnes which reached the highest during 1970-71, when it was 19.5 million metric tonnes. But during the period of reference there have been fluctuations. The overall annual rate of growth has been 1.9 per cent. This is too low a figure for a predominantly agricultural state, which cannot be concealed by the high rates of growth attained by certain affluent pockets.

This rate of growth is partly attributed to the marginal increase in area, but mainly to per hectare yield, because the area has increased from 17.1 million hectares to 19.3 million hectares only, with an annual growth rate of 0.53 per cent; whereas the yield per hectare has increased from 6.89 quintals to 9.38 quintals with an annual rate of growth of 1.35 per cent, which is attributable to the increased inputs.

The regional annual rates of growth (compounded) for the period 1950-51 to 1972-73 of output, area, yield per hectare for total food is given in Table 3.

Table 3

Retion	ANNUAL RATE OF GROWTH(%)		
	Output	Area	Yield per hectare
Western	2.41	0.55	1.84
Central	1.41	0.34	1.07
Bundelkhand	2.44	1.29	1.13
Eastern	1.23	0.27	0.95
Hill	2.92	1.02	1.27
U.P.	1.89	0.54	1.35

The table reveals that the highest per hectare rate of growth has been in the Western region followed by the Hill region. The Eastern region stands at the lowest level. The Central, Bundelkhand and Eastern regions have attained the growth rates lower than the state average. The Hill region has attained the highest growth in output, and Bundelkhand in the area.

Wheat is the major food crop production. The state has registered an increase of production by more than 2.8 tonnes, with the annual rate of growth (compounded) 4.5 per cent, while the area under this crop has increased by about 1.8 tonnes with a compound rate of growth of 2.7 per cent.

The regional break up of the rate of growth of production in descending order is as follows: Western 5.0 per cent, Bundelkhand 4.2 per cent, Eastern and Hill 4.1 per cent and Central 3.7 per cent.

The average per hectare yield has increased from 8.21 quintals to 12.25 quintals during the reference period, with a growth rate of 1.8 per cent per annum. The region-wise break up of the growth rate, in descending order, is as follows: Western 2.2, Bundelkhand 1.6, Hill 1.4, Eastern 1.3 and Central 1.1 per cent.

In each region, however, the contribution of area is more than that of the per hectare yield of wheat as may be seen in Table 4.

Table 4

Region	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	5.04	2.77	2.21
Central	3.66	2.50	1.14
Bundelkhand	4.18	2.54	1.60
Eastern	4.12	2.83	1.25
Hill	4.12	2.71	1.37
U.P.	4.52	2.71	1.76

Rice is next to wheat. In the state the total production of rice has increased from 7.5 lakh metric tonnes to 32.7 during the reference period. The production of rice has increased by 64 per cent with an annual rate of growth as 2.16 per cent. The regional variations, in descending order, are: Bundelkhand 3.4 per cent, Western 3.0 per cent, Central 2.3 per cent, Eastern 1.9 per cent and Hill 1.0 per cent. These figures underscore the point that the impact of Green Revolution has been mainly in respect of wheat and maize.

The area under rice cultivation has increased from 38.5 lakh hectares to 43.7 with an annual rate of growth of 0.5 per cent. There have been regional variations, in descending order, as shown below: Bundelkhand 2.1 per cent, Western 1.0 per cent, Central 0.6 per cent, Hill 0.5 per cent and Eastern 0.3 per cent.

The average yield of rice per hectare has fluctuated over the period—the trough being 4.4 quintals per hectare in 1951-52, and the peak being 8.16 in 1970-71. The yield has increased only by 1.3 times, with 1.6 per cent as annual growth rate. The regional variations in growth rate are : Western 2.0 per cent, Central 1.7 per cent, Eastern 1.6 per cent, Bundelkhand 1.3 per cent and Hill region registering a negligible growth rate of 0.003 per cent.

The contribution of area and yield to output of rice is shown in Table 5.

Table 5

Region	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	3.02	0.98	2.02
Central	2.28	0.55	1.72
Bundelkhand	3.43	2.14	1.26
Eastern	1.95	0.30	1.65
Hill	0.54	0.53	0.004
U.P.	2.17	0.54	1.60

The table reveals that the contribution of yield per hectare is much more than that of area cultivated.

Barley is nutritional, yet it is supposed to be, traditionally, a poor man's food. After independence there has been an expectational explosion. Agriculture has become a profitable sector. It is difficult to explain, but the paradox remains that both the production (from 17.1 lakh metric tonnes to 13.0) and area (from 19.5 lakh hectares to 12.9) have declined, while the yield per hectare has increased. The rate of decline in the production has been 1.2 per cent and that the decline in the area has been 1.8 per cent, in spite of the fact that the

prices of Barley have been higher than that of wheat. This negative picture holds good for the various regions as well. The average increase in the per hectare yield has been 1.2 times with an annual growth rate of 0.6 per cent. This is also reflected in the different regions except in Bundelkhand where the per hectare yield has declined by 10 per cent.

The contribution of area and yield per hectare to the output of barley is shown in Table 6.

Table 6

Region	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	- 2.48	- 3.34	0.90
Central	- 1.11	- 1.55	0.45
Bundelkhand	- 2.07	- 1.33	- 0.75
Eastern	- 0.65	- 1.28	0.63
Hill	- 0.05	- 1.52	1.48
U.P.	- 1.19	- 1.78	0.60

Maize has shown a reverse trend. Its production (from 6.5 lakh metric tonnes to 13.6) and area (from 8.3 lakh hectares to 14.8) have increased. The former has increased by more than twice with an annual growth rate of 3.2 per cent, while the latter has increased by 1.7 times with an annual growth rate of 2.5 per cent. Both in production and area, the Hill region tops (with annual rate of growth of production at 7.8 per cent and that of area at 4.4 per cent) and the Western region (with 4.8 per cent and 3.6 per cent rates of growth, respectively) stands second. The Eastern region comes at the bottom with the corresponding figures being 1.2 per cent and 1.1 per cent respectively.

The contribution of area and per hectare yield to the output of maize is shown in Table 7.

The table reveals that the contribution of area to output has been more than that of yield per hectare; may be because it is a kharif crop, requiring less of investment and depending more on rains.

Table 7

Region	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	4.76	3.57	1.14
Central	3.17	2.75	0.41
Bundelkhand	3.38	2.25	1.11
Eastern	1.25	1.10	0.15
Hill	7.79	4.44	3.21
U.P.	3.24	2.53	0.69

We have intentionally left out other food crops since they play a minor role in the total supply. But it may be added that Bajra, which was once poor man's food, has increased in production from 6.7 lakh metric tonnes to 7.2.

Pulses play an important role in providing protein in a predominantly vegetarian country. The habit of pulse consumption varies in U.P. from region to region. For example, in Eastern U.P. the consumption of Arhar is predominant whereas in Western U.P. it is Urd. Moong and Masoor are occasionally used. Gram is used not mainly as pulse but also in various forms, including the preparation of sweets.

Therefore, it is of significance that there should be a fall in both output of area under pulses, the respective figures being 0.15 per cent and 0.93 per cent annually. In 1950.51 the total area under pulses was 43.5 lakh hectares and the output was 30.2 lakh metric tonnes, the corresponding figures for 1972-73 are 35.1 lakh hectares and 29.2 lakh metric tonnes, respectively. However, the per hectare output has shown a positive result—0.78 per cent per annum. There are regional variations—Western U.P. being at the top with its 1.17 per cent annual rate of growth, and the Hill region registering a negative record—0.35 per cent per annum.

Under pulses, gram and arhar are the two most important crops. The production of gram has remained constant : in 1950-51 it was 14.5 lakh metric tonnes and 14.6 in 1972-73. The increase has nearly been 0.51 per cent and the annual growth rate has been 0.02 per cent. The regional production has varied : in the Eastern, Western and Hill regions there

have been falls in production by 4.2 per cent, 33.5 per cent and 17.0 per cent, respectively, whereas in Bundelkhand and Central regions there have been increases by 41.3 per cent and 16.6 per cent, respectively. The area under gram has fallen from 24.4 lakh hectares in 1950-51 to about 19.2 lakh hectares in 1972-73 with an average annual rate of decline as 1.03 per cent.

The contribution of area and yield per hectare of gram to output is shown in Table 8.

Table 8

Regions	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	- 1.76	- 3.32	• 1.62
Central	0.67	- 0.50	1.18
Bundelkhand	1.51	0.81	0.69
Eastern	- 0.18	- 0.93	0.77
Hill	- 0.80	0.75	- 1.54
U.P.	0.02	- 1.03	1.07

The contribution of per hectare yield is positive in the State as well as in the regions with the exception of the Hill, whereas the contribution of area has been negative except in Bundelkhand and Hill regions.

Arhar is the most widely consumed pulse among all types of pulses, even then it lags behind gram and other pulses in respect of output and area. The reason being that arhar can be consumed only in the form of pulse and in no other form, unlike gram, moong etc. The overall production of arhar in U.P. has increased to some extent during the period of reference. In 1950-51 the production was 7.4 lakh metric tonnes, which increased by about 17 per cent, raising the production to 8.7 lakh metric tonnes in 1972-73. The annual growth rate has, however, been as low as 0.67 per cent, in the face of rising population. The maximum increase in the production has been in Bundelkhand region when the production has more than doubled with a high growth rate of 3.8 per cent per annum. The production has marginally fallen in the Western region, but sharply fallen in the Hill region by about 80 per cent with a

negative annual growth rate of 6.8 per cent. The remaining regions show an improvement in production.

The area under cultivation was 6.5 lakh hectares in 1950-51 and it declined to 5.6 [illegible] in 1972-73. This decline in area is mainly due to the single use of, and low returns from arhar. The area has declined in three regions, but it has increased fairly in the Bundelkhand and in the Eastern regions.

The yield per hectare has, however, increased significantly. It has increased by 1.3 per cent per annum in the State, while 2.7 per cent per annum in the Bundelkhand region. It has declined only in the Hill region from 21.26 quintals per hectare in 1950-51 to 17.66 quintals per hectare in 1972-73.

The contribution of area and yield per hectare to the output of Arhar is shown in Table 9.

Table 9

Regions	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	- 1.43	- 2.53	1.12
Central	0.72	- 0.71	1.45
Bundelkhand	3.80	1.04	2.73
Eastern	1.76	0.48	1.27
Hill	- 6.77	- 6.01	- 0.80
U.P.	0.67	- 0.60	1.28

It is obvious from the table that the contribution of yield per hectare has an edge over area under cultivation.

Besides gram and arhar there are other pulses like Urd, Moong, Masoor, whose production contributes to the total production of pulses. Among these, Masoor occupies the main position. Its production has increased from 38.3 thousand metric tonnes in 1950-51 to 117.6 thousand metric tonnes in 1972-73. This means that the production has increased by more than 3 times during the reference period. The production of Urd and Moong had, however, fallen. The production of Urd was 87.0 thousand metric tonnes in 1950-51, which fell to 56.6

thousand metric tonnes in 1972-73—a fall of about 34 per cent. In the case of moong the production fell from 5.8 thousand metric tonnes to 3.2, registering a fall of about 35 per cent.

The same trend is found for the area under cultivation of these pulses. The area has increased in the case of Masoor and has fallen in the case of Urd and Moong. The increase has been about 16.3 per cent in case of Masoor. The respective falls in the case of Urd and Moong are: 62.2 per cent and 66.7 per cent.

The yield per hectare has shown an increasing trend in all these pulses. It has increased with an annual rate of growth of 2.8 per cent in the case of masoor followed by 2.0 per cent in the case of urd. It is interesting to note that the production of masoor has shown an increasing trend in each sub-region of U.P. The average yield per hectare of urd has increased marginally in the State with 0.2 per cent per annum rate of growth. Moreover, the Hill region has shown an annual growth rate of 1.4 per cent. The Western and Central regions have also shown an increasing trend. The State average gives a low figure about Bundelkhand, and the Eastern region shows a negative trend. The yield per hectare in the case of moong has gone down. It has only increased in the Western region. One can safely conclude that the overall shortage in the supply of pulses is not because of a stagnant rate of per hectare yield but because of the fall in the area under pulse cultivation. It may further be added that the Green Revolution has not touched the pulses.

Oil Seeds: Besides cereals and pulses, oil seeds contribute significantly to the total agricultural wealth in the State. We have, in all, five types of oil seeds—ground-nut, rapseed and mustard, linseed, til and castor. The total production of oilseeds in the State has increased from 1.8 lakh metric tonnes in 1950-51 to 4.3 in 1972-73, registering a total growth of about 141 per cent with an annual rate of growth of 3.81 per cent. The Western region has shown a growth of about 208 per cent, with 5.24 per cent as the per annum growth. The Central and Hill regions show around 13.5 per cent growth, with 3.82 and 3.66 per cent annual rates of growth, respectively. The Eastern region registers a rise of 70 per cent with 2.28 per cent annual rate of growth. Only in the Bundelkhand region the production has declined, and it dropped to 15.1 thousand metric tonnes from 23.5. The rate of decline is 1.91 per cent per annum.

The area under cultivation of oilseeds has approximately doubled during 1950-51 and 1972-73. It grew from 3.5 to 6.6 lakh hectares with an annual rate of growth of 2.83 per cent. Here the regional variations are not in accordance with the variations in the production of oil seeds. In the central and Western regions, the area has increased by about 169 and 162 per cent; their respective annual rates of growth being 4.42 and 4.32 per cent. In the Eastern region the corresponding increase is about 72 per cent, with 2.52 per cent as the annual rate of growth. The Hill region shows a rise by 61 per cent with an annual rate of growth of 2.07 per cent. The area under cultivation in Bundelkhand has declined by about 30 per cent, with a negative annual growth rate of 1.55 per cent.

The yield per hectare in the State has increased at the rate of 0.95 per cent per annum. The maximum increase has been registered in the Hill region, followed by the Western region; the respective annual rates of growth being 1.56 and 0.88 per cent. The remaining regions have shown a fall in the yield per hectare. The regional variations in the annual rates of fall, in descending order, is as follows: Eastern 0.24 per cent, Bundelkhand 0.37 and the Central 0.59 per cent.

The contribution of area and yield per hectare, to the total output of oilseeds is given in Table 10.

Table 10

Regions	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	5.24	4.32	0.88
Central	3.82	4.42	- 0.58
Bundelkhand	- 1.91	- 1.55	- 0.37
Eastern	2.28	2.52	- 0.24
Hill	3.66	2.07	1.56
U.P.	3.81	2.83	0.95

The table reveals that the contribution of the area under cultivation to the output is much more than that of yield per hectare. In most of the sub-regions, the yield per hectare has been a crucial factor in falling production.

Groundnut: The production of groundnut in the State has increased from 1.03 lakh metric tonnes to 2.87, which means a rise of over 183 per cent with an annual rate of growth at 4.6 per cent. The production has increased in each sub-region, and the maximum rise has been as high as 255 per cent in the Western region. The area under cultivation in the State has increased from 89.1 thousand hectares in 1950-51 to 314.9 in 1972-73 showing an increase of over 253 per cent, with 5.6 per cent annual rate of growth. Again the Western region takes the lead over the rest of the regions, and the increase has been in the order of 347 per cent. It is interesting to observe that in spite of high growth, both in production and area under cultivation of groundnut, the yield per hectare has constantly declined in the State and its sub-regions. Table 11 clearly explains the situation.

Table 11

Regions	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	6.00	6.78	- 0.73
Central	3.39	4.57	- 1.22
Bundelkhand	8.85	10.10	- 1.13
Eastern	3.37	5.16	- 1.71
Hill	7.67	9.28	- 1.47
U.P.	4.56	5.64	- 1.03

Something is radically wrong with the cultivation of groundnut, since the per hectare yield is declining in all the regions. This must be corrected.

Rapeseed and Mustard: The production of rapeseed and mustard in the State has increased from 43.1 thousand metric tonnes to 119.1 during the reference period showing a rise of over 177 per cent, with an annual rate of growth at 4.5 per cent. The Central and Bundelkhand regions are the main contributors. In these regions the production has increased by over 344 per cent in each case. The rest of the regions also show significant rise. The area under cultivation in the State has increased by 87 per cent, with an annual rate of growth at 2.8 per cent. The maximum increase being in the Bundelkhand

region (378 per cent) followed by Central region. In the rest of the regions also, the area has vastly increased. The yield per hectare in the State has increased at the rate of 1.7 per cent per annum. It is surprising that both production and area under cultivation in the Bundelkhand have been maximum, but it is the only region where the yield per hectare has gone down (at the rate of 0.2 per cent per annum). A region-wise comparative figures have been shown in Table 12.

Table 12

Regions	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	3.90	2.09	1.77
Central	6.74	4.82	1.82
Bundelkhand	6.84	7.05	- 0.20
Eastern	3.27	1.97	1.27
Hill	3.72	2.04	1.65
U.P.	4.51	2.76	1.71

Linseed: The production of linseed in the State has marginally declined. However, both in the Western and Hill regions the production has doubled and marginally increased in the Eastern region. Even then the State shows a decline. This is because of the fact that in the rest of the regions, namely, the Central and the Bundelkhand the production has sharply declined. In the State as well as in the sub-regions, when the production has increased, the area under cultivation has also increased. Further, in the region when the production declined, the area has also decreased. In addition to this the yield per hectare has everywhere declined. In the State it has declined at the rate of 1.8 per cent per annum and the maximum decline has been in the Hill region at the rate of 2.3 per cent per annum. Thus it is mainly the yield per hectare which is responsible for regional variations in production.

Til and Castor: Their contribution in the output of oil-seeds is negligible. The important points to note are: (i) the production of til has fallen in the State and its sub-regions, except in the Eastern and Hill regions, where the production has significantly increased. The production of castor has

everywhere fallen. (ii) The area under cultivation in the case of castor has declined everywhere, and that in the case of til has declined in the state and the Bundelkhand region. The area has increased elsewhere. The State average has declined due to the fact that the increases have been negligible while the decline has been monotonic. (iii) The per hectare yield of castor has increased everywhere and that of til in the Eastern and Hill regions, with annual rates of growth as 0.6 per cent and 0.4 per cent annually. The rate of decline in the State has been 0.16 per cent.

True, the yield, output and area under cultivation of oilseeds have increased. But they have lagged behind the population growth. This explains the edible oil crisis.

Commercial Crops: The important commercial crops in U.P. are jute, cotton, tobacco, sugarcane and potato. The production of jute in the state has increased from 49.5 thousand metric tonnes in 1950-51 to 93.8 in 1972-73. The overall growth has been over 90 per cent, with an annual growth rate of 2.82 per cent. The Central and the Eastern regions together produce about 92 per cent of the State output. Jute is not cultivated in the Bundelkhand region and the share of Hill region is negligible. The area under cultivation of jute in the State was 9.7 thousand hectares in 1950-51, which grew to 10.6 in 1972-73. The per annum rate of growth registered is 0.42 per cent only. In area also the share of Central and Bundelkhand regions together cover about 92 per cent of the total area cultivated in the State. It may be noted that the share of each region in terms of production and area is exactly the same. This is due to the fact that the yield per hectare is the same for the state as well as its sub-regions. This view is supported by the data in Table 13.

Table 13

Region	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	- 0.41	- 0.73	2.39
Central	2.60	0.20	2.40
Bundelkhand	--	--	--
Eastern	5.20	2.74	2.40
Hill	- 7.04	- 9.21	2.39
U.P.	2.82	0.42	2.40

The constancy of the yield per hectare shows that equal efforts have been made in each region.

Cotton: The production of cotton in the State has declined from 44.5 thousand metric tonnes to 36.7. The rate of fall has been 0.83 per cent per annum. The Western region contributes 98 per cent of the total produce. It is important to note that the production has increased in the Central and the Eastern regions, while it has fallen in the other two. The maximum fall has been in the Bundelkhand region where the production is constantly falling, but the area under cultivation has increased. It was 42.8 thousand hectares in 1950-51 and 46.7 in 1972-73. The rate of growth per annum is at 0.38 per cent. The Western region covers about 98 per cent of the total area under cultivation. The area in the Hill region has sharply fallen at a rate of 13.32 per cent per annum resulting in negligible production. The yield per hectare has fallen in the State at the rate of 1.22 per cent per annum. The maximum increase in the yield per hectare is in the Bundelkhand region, followed by the Eastern region. A table showing the contribution of area and yield per hectare to the output for various regions is given below:

Table 14

Regions	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	- 0.80	0.48	- 1.29
Central	1.47	1.18	0.26
Bendelkhand	-22.22	-24.15	2.54
Eastern	0.04	- 1.72	1.81
Hill	-13.40	-13.32	- 0.07
U.P.	- 0.83	0.38	- 1.22

The table reveals that in 2 regions area has contributed to yield, and in 3 regions the per hectare yield.

Tobacco: Tobacco is cultivated mainly in the Western and Central regions, which together produce about 83 per cent of the State production. The overall production of tobacco in the State has fallen. The figure for 1950-51 was 13.0 thousand

metric tonnes which fell to 10.8 during 1972-73. The annual rate of fall has been 0.81 per cent per annum. This falling tendency has been maintained in each sub-region of U.P. The area under cultivation has also fallen in the state and its sub-regions. In 1950-51, 17.2 thousand hectares was under cultivation in the State and this figure fell to about 11.1 in 1972-73. The negative growth rate has been 1.91 per cent annually. The yield per hectare has increased in the State and in all the regions except one, namely the Hill. In the state the rate of increase has been 1.12 per cent per annum and it is exactly 1.4 per cent in each region. In Hill region the rate of fall is 0.01 per cent.

The contribution of area and yield per hectare to the output of tobacco is shown in Table 15.

Table 15

Regions	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	- 0.32	- 1.73	1.43
Central	- 2.29	- 3.66	1.42
Bundelkhand	- 2.40	- 3.79	1.44
Eastern	- 3.24	- 4.61	1.44
Hill	- 0.24	- 0.14	- 0.10
U.P.	- 0.81	- 1.91	1.12

The table reveals that both output and area under cultivation have fallen in the State and its sub-regions, but the yield per hectare has increased everywhere, except in the Hill region.

Sugarcane: Uttar Pradesh is one of the largest producers of sugarcane in the country. In 1950-51 the production was 29.5 million metric tonnes, which increased to 56.7 in 1972-73—an increase of over 93 per cent, with 2.9 per cent annual rate of growth. The largest producer being the Western region, with its share of over 61 per cent of the total output, followed by the Eastern region with a share of 23 per cent. A negligible share (0.2 per cent) is contributed by the Bundelkhand region. The production in each sub-region has increased, the maximum being in the Hill region, with an annual rate of growth of 9.07 per

cent. The

In 1950-51, the area under cultivation in the State was 5.7 lakh hectares, which increased to 7.4 in 1972-73. The area increased by 30 per cent with 1.1 per cent rate of growth per annum which is the maximum in the Hill region, touching 7.7 per cent. The yield has increased from 291.1 quintals per hectare to 433.7 during the reference period, the per annum rate of growth being 1.75 per cent. The contribution of area under cultivation and the yield per hectare to the output of sugarcane is shown in Table 16.

Table 16

Region	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield per hectare
Western	2.82	1.14	1.66
Central	2.14	0.80	1.33
Bundelkhand	1.57	0.62	0.94
Eastern	3.11	0.88	2.21
Hill	9.07	7.74	1.31
U.P.	2.88	1.11	1.75

The above table reveals that the contribution of yield per hectare to the total output has been more than that of the area under cultivation in the State as well as its sub-regions, with the exception of the Hill region, where the area has contributed about 8 times more than per hectare yield.

Potato: The data about production, area under cultivation and yield per hectare of potato relate to the Rabi. It is the only commercial crop which, in the most usual form, is directly consumed. The production of potato has more than doubled in the State and its sub-regions, except in the Hill, where it has increased more than six times. The State output was 6.4 lakh metric tonnes in 1950-51 and the corresponding figure in 1972-73 was 16.0 lakh metric tonnes. The Western and the Eastern regions are the main producers of potato. The least being cultivated in the Bundelkhand region. The area under cultivation was 82.0 thousand hectares in 1950-51, in the State, which increased to 171.4 thousand hectares in 1972-73. In the Hill

region the area has increased more than 9 times. The increases in the rest of the regions vary between 80 to 120 per cent. The yield per hectare of potato was 78.08 quintals in the State, which increased to 93.13 during the reference period. Table 17 presents annual rates of growth (compounded) in the output, the area under cultivation and the per hectare yield.

Table 17

Regions	ANNUAL RATE OF GROWTH (%)		
	Output	Area	Yield Per hectare
Western	4.53	3.76	0.74
Central	3.51	2.80	0.69
Bundelkhand	3.73	3.28	0.44
Eastern	3.62	2.54	1.05
Hill	8.22	10.14	- 1.74
U.P.	4.05	3.26	0.77

The table reveals that the output has mainly increased due to the increase in the area under cultivation. The contribution of yield per hectare has been marginal in the State and in all, but one, sub-regions. The per hectare yield in the Hill region, in fact, has retained the growth in output. In spite of this, the maximum increase in output has been in the Hill region, as the area increases at the rate of 10.14 per cent per annum.

VI. Crop Intensity

The intensity of land utilisation is reflected in the number of crops during a year. The crop intensity is defined as the percentage of total cropped area to the net area sown. Thus the formula is:

$$\text{Crop Intensity} = \frac{\text{Total cropped area}}{\text{Net area sown}} \times 100$$

It is noteworthy that crop intensity is not necessarily related to labour requirement per hectare. Double cropping cannot be practised with all crops, for example, sugarcane and arhar are one-year crops, therefore, double cropping is not

possible. Crop intensity is directly related to the output and employment. The higher the value of crop intensity, the higher will be the level of production.

The intensity of cropping in the State has increased from 23.38 in 1950-51 to 32.05 per cent in 1972-73—a rise of 37.00 per cent. The Hill region has registered the maximum rise of over 86 per cent. The crop intensity increased from 37.67 to 70.34 per cent, during the period of reference. In the Bundelkhand and the Eastern regions, the overall growth in the crop intensity has been around 76 per cent. The Central region registered a growth of about 30 per cent, while the Eastern region stands at the lowest with a rise of only 6.6 per cent.

Table 18 gives the value of crop intensity for various regions in different years and its annual rate of growth.

Table 18

Regions	CROP INTENSITY (%) 1950-51	1955-56	1960-61	1965-66	1970-71	1972-73	Annual rate of growth (%)
Western	22.05	24.67	27.05	28.70	39.40	39.05	2.51
Central	22.54	24.58	26.99	28.27	30.59	29.24	1.14
Bundelkhand	6.32	6.71	9.17	8.21	10.32	11.12	2.49
Eastern	29.58	30.72	31.69	32.42	34.02	31.53	0.28
Hill	37.67	36.99	41.92	46.47	55.63	70.31	2.76
U.P.	23.38	25.07	26.95	27.83	33.03	32.05	1.38

The table reveals that in the Hill region the intensity of cropping has grown at the rate of 2.76 per cent per annum. In the Western and Bundelkhand regions, the annual rate of growth has been 2.5 per cent. The Central region, with 1.14 per cent, annual rate of growth, the Eastern with 0.28 per cent fall below the State average, where the corresponding figure is 1.38 per cent. It is interesting to observe that the Bundelkhand region registers a very high rate of growth, with the lowest crop intensity and the Eastern region registers the lowest rate of growth with a high intensity of cropping. Thus, in these regions the practice of double or multiple cropping has not been very popular.

VII. An Approximation to Conclusion

From the organisational viewpoint we find that peasant proprietorship is the dominant form of land tenure in U.P. But the concentration of land is acute. Seventy five per cent of the total area of landholdings is below 5 hectares. Therefore it is inherent in the system that technological advantage cannot be equally availed by different categories of landholders unless suitable organisational changes, comparable with the genius and traditions of a given group of cultivators, are introduced. If we undertake an exercise in identifying the factors responsible for growth of output, we find that in the Hill region, the area under land utilisation has declined by 3 per cent, but has increased in other regions—Eastern U.P. standing at the top with 2.8 per cent increase. But in the growth of total food production, the progress registered in the Hill region is 94 per cent, whereas in the Eastern region it is only 33 per cent. Irrigation, however, provides a clue. In the Hill area, the total irrigated area has increased by 114 per cent whereas in the Eastern U.P. it is only 30. This is connected with the consumption of fertilizers which has increased by 7486 per cent in the Hill region, whereas in the Eastern U.P. it is 2200—the State average being 19000 per cent.

Then the crucial factors are: water management and adequate input of fertilizers. These cannot be made available to small and marginal farmers unless service cooperatives are organised. Further, with increasing cost of labour and maintenance of bullocks, mechanisation is inevitable accompanied with the availability of water, fertilizers and improved seeds, which imply double and triple cropping and labour intensive agricultural operations. Here again some sort of MTS at the block level is called for. Without this growth of agriculture is bound to be kulak oriented and economic disparities will widen.

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Appendix I

A NOTE ON METHODOLOGY

We have classified Uttar Pradesh into the following five sub-regions, mainly based on economic and agro-climatic conditions, such as (i) Western Region—Saharanpur, Muzaffarnagar, Meerut, Bulandshahr, Aligarh, Mathura, Agra, Mainpuri, Etah, Bareilly, Bijnor, Badaun, Moradabad, Shahjahanpur, Pilibhit, Rampur, Farrukhabad and Etawah; (ii) Central Region—Kanpur, Fatehpur, Lucknow, Unnao, Rae Bareli, Sitapur, Hardoi, Khiri, and Barabanki; (iii) Bundelkhand Region—Jhansi, Lalitpur, Jalaun, Hamirpur and Banda; (iv) Eastern Region—Allahabad, Varanasi, Mirzapur, Jaunpur, Ghazipur, Ballia, Gorakhpur, Deoria, Basti, Azamgarh, Faizabad, Gonda, Bahraich, Sultanpur and Pratapgarh; (v) Hill Region—Dehradun, Nainital, Almora, Pithoragarh, Garhwal, Chamoli, Tehri-Garhwal and Uttarkashi.

The study is based on analysis of the trends in production from 1950-51 to 1972-73. This exercise is based on relating output (measured in physical terms) to inputs. The main sources of data have been the following publications of the Directorate of Agriculture, and the Director of Economic and Statistics U.P: (a) Uttar Pradesh ke Arthik Kshetravar Ankade: 1975, published by the Directorate of Agriculture, U.P.; Uttar Pradesh ke Krishi Ankade : 1975, published by the Directorate of Agriculture, U.P.; Statistical Abstract, U.P., 1973-74; Statistical Diary, 1973 and 1975, published by the Directorate of Economics and Statistics, U.P.; and (b) Twenty four years of Plant Protection in U.P. published by Plant Protection Services, U.P.

From these sources the data were tabulated for the State and its sub-regions. The entire calculations have been made with the help of desk calculator. Later, the Micro-2200 computer was mainly used for compounded annual rates of growth. The figures in the tables have been rounded off for the sake of simplicity. But the proper degree of approximation has always been taken into account. Throughout the study, it has been the main consideration that the generality of the data is not lost. The trends have been determined mainly on the basis of 3 yearly moving averages.

The analysis of data has been related to the tenurial conditions, the pattern of land holdings, the relation of output with leading inputs. An attempt has been made to explain the sources of agricultural growth in the State and its sub-regions. The inter-regional comparison has also been made.

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AGRICULTURAL DEVELOPMENT IN MADHYA PRADESH

A STUDY OF RATES, PATTERN AND PRODUCTION RELATIONS, 1950-51 to 1973-74

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The importance attached to agriculture and its role in the growth process has received differential degrees of emphasis both in literature and policy through time. Three distinct thought streams can be distinguished in the literature of last three decades or so. (Streeten, P., Ref.6). During the period from the end of the Second World War to the mid-fifties, agriculture was supposed to play a secondary role of providing labour, raw materials and other resources to develop manufacturing and other activities. During the next decade, the emphasis shifted from industrialisation to balanced growth. But recently, the role of agriculture in the growth process of developing economies as a generator of employment opportunities for the ever rising number of job seekers and as the single largest contributor to the national output is greatly highlighted. The swing in favour of agriculture has been accompanied by a shift in policy regarding the allocation of investible resources between agricultural and non-agricultural sectors of the economy.

Like the national economies of the developing countries, their agriculture is also characterised by dualism. Progressive farm production for the market is surrounded by the traditional subsistence cultivation. Besides, different regions differ sharply in resource endowment which accounts for a major share of the existing regional inequalities in agricultural development. These inequalities have tended to further accentuate by the developmental efforts that have remained concentrated mainly in regions richly endowed with the natural resources like more fertile soil, better irrigational facilities, etc. Though agriculture and household industries have been assumed to take care of the regional development in the planned programmes, the scarcity of resources and the considerations of productivity of investment have caused an extension of the principle of selectivity in the choice of growth centres

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* All data for the paper have been processed by Mr. P. Rajan, Lecturer, Department of Economics, Union Christian College, Barapani (Shillong). For all practical purposes, he may be considered a co-author of the paper.

from industries to agriculture. Such an approach to development has created rural regional inequalities which are similar to those created by the concentration of industries in few urban regions. (Ref.4).

The regional inequalities of agricultural development can be reduced only if the backward regions are enabled to quicken the pace of development. Besides, a vast and agricultural country like India can attain an appreciable degree of agricultural development only if the process of growth spreads throughout and it embraces all the major crops of different regions of the country. The attainment of this objective necessitates a detailed examination of the problems, processes, trends and patterns of agricultural development in each individual region of the country. The present study attempts to analyse the rates and pattern of agricultural development and the relationships between output and the modern factor inputs in the state of Madhya Pradesh which is almost as varied in agro-climatic conditions as the country as a whole.

Broad outlines of the ensuing analysis are as follows: Section I analyses the rates and pattern of agricultural development. Section II is devoted to the analysis of the relationship between output and factor inputs both for time series and cross section data. Last section contains conclusions and resume. Sources of data and assumptions relating to them are given in the appendix.

I

Rates of Agricultural Development :

Recent experience in India has highlighted the importance of agriculture in the growth process of the economy. It shows that whenever the agricultural sector records a substantial increase in its production, it is accompanied by an all-round prosperity in the economy as a whole, and on the other hand, whenever the agricultural sector performs poorly in terms of production and its growth, it lowers down the over all performance of the entire economy. This is true about the state of Madhya Pradesh also where agriculture has led the rest of the sectors of the economy in the generation of additional income. The growth of real agricultural income has been twice as fast as that of the total income during the period from 1951 to 1972 (Ref.5).

Agricultural development is defined in terms of the

rates of output per unit of time. The following equation has been used to estimate the growth rates.

$$Y = A e^{bT}$$

$$\text{or} \quad \log Y = \log A + bT \qquad \ldots\ldots\ldots(1)$$

where Y is the variable whose growth is to be measured, T is time, A and b are constants of the equation, b gives the rate of growth of Y per unit of time T. Year is taken as the unit of time in the study.

Production per acre, area and the intensity of cropping are the major determinants of the growth of agricultural output. Area under cultivation can not increase beyond a limit for reasons that are obvious. The cropping intensity is mainly dependent upon irrigational facilities and the availability of quick maturing crops that are suited to the agro-climatic conditions of a region. Naturally, the growth of yield per acre emerges as the leading factor of agricultural development[1]. Yield per acre is mainly a function of the modern inputs like high yielding varieties of seeds, irrigation, fertilisers, management, soil-climatic conditions and pesticides. As the data for cropping intensity are not available for most of the years covered by the study, only the other two factors of agricultural development have been examined. The rates of growth of output, area and the yield per acre have been estimated by equation (1) which has been fitted to the data by least squares method. The estimated growth curves for output, are and yeild per acre for 27 different crops raised in the state of Madhya Pradesh are shown in table (1). The period covered is from 1950-51 to 1973-74.

The table shows that the production of pulses has increased at a rate of 1.52 per cent per annum, output of cereals and millets has increased at a slightly lower rate of 1.32 per cent per annum and the production of oil-seeds has expanded at a rate of even less than 1 per cent per annum. Both the area and yeild per hectare of cereals have increased at 0.91 per cent per annum while the area under pulses has grown twice as fast as the yeild per hectare. The area under oil-seeds has increased at a rate five times greater than the rate at which yield per hectare has increased. Thus, the growth of acre and yield per hectare share the growth of production of

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1. Two types of growth processes can be distinguished; Growth process initiated and sustained by factor multiplication and the growth process initiated and sustained by the factor transformation. Yield per acre increases generally by factor transformation. For details, See Ref. 1, P.66.

cereals and millets equally whereas the growth of area under pulses has contributed the major share to the growth of their output. But the growth of production of oil-seeds is almost entirely accounted for by the growth of area under them.

The following are the important features of the estimated curves :

(1) Barley, ground-nut, castor-seed, sunhemp and tubacco are the five gcrops that show negative growth of area under cultivation. Four out of these five crops are cash crops. Barley is the only cereal crop that shows negative growth of area under cultivation. It seems that the increasing profitability of cereals, pulses and other cash crops has made the cultivation of these crops less attractive to the farmers of the state. The profitability or the attrativeness of a crop depends largely upon its price relative to the prices of other crops and its per hectare yeild. We find that while the yield per hectare of sunhemp and castor seed has remained stagnant, the yield per hectare of ground-nut and tubacco has increased at rates as low as 0.76 per cent per annum. This must have induced the farmers to transfer area from these crops to those with higher yields. Besides, the movement of relative prices must have further decreased the attractiveness of these crops. For example, the price of barley relative to that of rice decreased from 0.83 in 1965 to 0.61 in 1972, the relative price of ground-nut decreased from 1.56 in 1965 to 1.43 in 1972 and the relative price of tubacco decreased from 6.14 in 1965 to 4.73 in 1970. These facts support the above hypothesis.

(2) The highest rate of growth of area under cultivation is 2.84 per cent per annum for mesta and the lowest rate of growth is 0.14 per cent per annum, for cotton. Thus, both the highest and the lowest rates of growth of area under cultivation is recorded by commercial crops other than oil seeds. The area under mesta shows such high growth despite the fact that its yield per hectare has been decreasing at a rate of 2.62 per cent per annum. Such decrease in yeild rates must reduce the attractiveness of the crop to the farmers. The fact that the crop became more attrative to the farmers can be explained only in terms of the relative price of mesta rising to a level which must have more than compensated for the loss in yield per hectare. The higher relative price of mesta must have induced the farmers to increase area under mesta and in the process even those lands might have been put under mesta which were not suitable for its cultivation with the result that the yield per hectare declines at such a high rate over time.

The negligible rate of growth of area under cotton implies that the total area under the crop has remained, more or less stagnant. It is not surprising in view of the fact that, on the one hand, the yield per hectare of cotton has been decreasing at a negligible rate of 0.17 per cent per annum, and on the other hand, its price relative to that of rice declined from 2.49 in 1961 to 1.92 in 1973-74. These two factors must have made crop less attrative to the farmers.

(3) The highest rate of growth of output is 5.62 per cent for maize while the lowest rate of growth of output is 0.60 per cent per annum for kodokutki. Thus, both the highest and the lowest growth rates are recorded by the cereal crops. The high rate of growth of output of maize is accounted by the fact that both the area and productivity of maize show relatively high growth rates. Increasing yield per hectare made possible by hyv seeds and other modern inputs and the increasing price which rose from 27.93 Rs. per quintal in 1961 to 68.76 in 1972-73, an increase of more than 100 per cent, must have provided an incentive to the farmers to raise the output of maize. On the other hand, kodokutki shows a growth rate of 0.30 per cent per annum both for area and yield per hectare which implies near stagnancy for both. But it is a minor crop of the state.

(4) Five out of 27 crops show negative growth of output and all these crops happen to be the cash crops. Decrease in area under sunhemp and tubacco account for the decrease in their output, while the decrease in yield per hectare account for the decrease in output of sesamum, mesta and cotton.

(5) The number of crops that show negative growth of output per hectare is also five. Two of them are oil-seeds and the other three are also commercial crops other than oil seeds: mustard-seeds, sesamum seeds, mesta, cotton and sugar-cane. But the area under all the five crops has increased during the same period. The rising prices of the crops must have acted as an incentive to the farmers to increase the area under the crops. The absolute price level of sesamum in 1972-73 is more than three times its level in 1961, that of mustard seeds is nearly 2.5 times its price in 1961 while the prices of cotton and sugar cane in 1973 are more than double and four times their prices in 1961, respectively. It is interesting to note that not only the output per hectare but the total output of sesamum, mesta and cotton also decrease while the total output of sugar-cane and mustard show some increase during the same period. The opposite trends shown by the growth of area, on the one hand, and the growth of output and

yield per hectare on the other, may perhaps be explained in terms of the changes in the relative prices. Despite the phenomenal rise in the prices of these crops, their relative prices have not changed favourably. For example, the price of mustard-seeds relative to that of rice decrease from 1.8 in 1961 to 1.5 in 1973, price of cotton decreases from 2.49 in 1961 to 1.92 in 1973 while the prices of sesamum and sugar-cane have remained un-changed, more or less. Besides the attractive relative prices, the availability of hyv seeds and other complementary inputs for the cereal crops like wheat, paddy, jowar and maize might have induced the farmers to reserve more fertile land for the cereal crops and transfer the less fertile land to the cultivation of these cash crops. But the steep rise in the absolute prices of thecrops might have more than compensated the farmers' loss caused by the decrease in yield per hectare.

(6) The proportion of the growth of output accounted by the growth of area under 'other cereals', tur, urad, moong/moth, masoor, sesamum, rape/mustard, lin-seeds, potato, mesta, cotton, and sugar cane in larger than the proportion accounted by the growth of their yield per hectare. Thus, almost all the pulses fall under this category. Unlike cereals, area under all pulses, except lakh, has expanded faster than the yield per hectare. The growth of output of pulses has resulted largely from the growth of area under them. While wheat replaced other crops in Punjab and Haryana, making those states major producers of the crop in the country, pulses seem to have found the favour with the farmers in the state of Madhya Pradesh. The increase in prices of pulses seems to have acted as the chief motivating factor. In 1973, the price of gram is 3.5 time higher than its price in 1961, the price of tur is 4.2 times more whereas the price of masoor is 3.5 times higher than its price in 1961. Besides, the relative prices of pulses have also been highly attractive. For examble, the price of gram relative to that of rice rose from 0.97 in 1961 to 1.05, the relative price of tur increases from 0.97 to 1.3 and that of masoor rises from 0.90 to 1.01 during the same period. The attractiveness of the prices of pulses must have induced the farmers to increase the area under the pulses. Consequently, the state of Madhya Pradesh emerges as one of the major producers of the pulses in the country. The table 2 shows that whereas the share of M.P. in the production of gram rises from 15.44 to 24.36 per cent of the total output in the country, its share in the production of total pulses increases from 7.47 per cent in 1951 to 19.85 per cent in 1974. Thus, nearly one fifth of the total production of pulses in the country is accounted by the state of Madhya Pradesh.

For other crops, the growth of yield per hectare accounts for a larger proportion of the growth of output than that accounted by the growth of area under cultivation. The growth of yield per hectare of all the cereals, except 'other cereals' has grown faster than the areaunder them. But the contribution of the growth of yield per hectare to the growth of production of rice, wheat, gram, kodokutki lakh and 'other oilseeds' is only negligibly higher than the contribution of the growth of area under cultivation. But for other remaining crops, the growth of yield per hectare is largely responsible for the growth of their output.

(7) Within the cereals and millets, maize, jowar, bajra and wheat, in that order, lead the rest of the crops in the growth of output and yield per hectare. It may be noted that hyv seeds have been evolved for all the four crops. Another interesting point is that wheat, which has been mainly responsible for the Agricultural development in the states of Punjab and Haryana, has trailed behind the course grains in the state of Madhya Pradesh. One of the reasons seems to be that the state of Madhya Pradesh has got much less irrigational facilities than Haryana and Punjab and due to soil-climatic and other conditions, larger proportion of irrigated area is under rice than wheat cultivation. The growth of areaunder wheat has also trailed behind the growth of area under maize but its growth has been faster than the growth of area under jowar and bajra. The growth of area under maize might be due to its small value in the base year.

The above analysis shows that (i) agricultural development in Madhya Pradesh has proceeded slowly but steadily. Production, area and yield per hectare of all but five crops have intreased at varying annual rates of growth. In fact, the production of cereals and millets and pulses has grown faster than their production in the country as a whole. The state's share in the production of cereals in the country increased from 6.99 in 1951 to 9.03 per cent in 1973-74. Similarly, the state's share in the production of pulses in the country increased from 7.47 in 1951 to 19.85 per cent in 1974. Crop-wise, the share of the state in the production of jowar, bajra, maize, gram and ground-nut has increased during the same period. The highest increase in the state's share in the country's output is for gram. (ii) The process of agricultural development in M.P., unlike that in Punjab, has been mainly led by the growth of production, per acre yield and area under course grains and pulses. Both wheat and rice have trailed behind them. The state's share in the production of jowar, bajra, maize and gram in the country has gone up but

its share in the production of rice and wheat has decreased. The growth of output of course grains in M.P. has been faster than their growth in the country as a whole while the growth of output of wheat and rice in the state has been slower than the growth of their output in the country. (iii) Another interesting feature of the process of agricultural development in M.P. is that the growth of area has been mainly responsible for the growth of output of several important crops.

II

Productions Relations of Agriculture :

Agricultural production is generally a function of the farm inputs, adoption of improved cultural practices, governmental programmes of agricultural development and the agro-climatic conditions. Of all these, the new farm technology has been found to be the single most important factor in the agricultural development of several countries/regions. In fact, it is the new farm technology that has been responsible for taking the agriculture of some developing economies out of the low level equilibrium trap (Mudhar, M.S., 1974, P.1). The diffusion and the adoption of the new farm technology hinges upon, among other things, the availability of modern inputs like high yielding crop varieties, fertilisers, pecticides, irrigational facilities, rural credit, new tools and machines for farming operations, and above all, an appropriate policy frame.

In case of Madhya Pradesh, the growth of area has been found to be an important determinant of agricultural development. Irrigation is also likely to play an important role in the process of agricultural development. It is, therefore, assumed that a very high proportion of the systematic variation in agricultural output can be explained in terms of the changes in area cultivated and irrigation. But agricultural production has also got a strong trend relationship (See, for example, Prakash, S. and Rajan, P., 1976). Even if production data are corrected for changes in technology and area cultivated, they may still contain the effects of other factors such as policies, prices, crop rotations etc. Some of these factors might even be completely unknown or immeasurable and they may change slowly and smoothly with time. Therefore, it has been assumed that time can be taken as an index of all other factors. Consequently, production depend not only upon area and irrigation but also upon time. Step-wise correlation/regression analysis is used to study the inter-relations among the above mentioned variables as the determinants of agri-

cultural output, from the year 1950-51 to 1973-74. We postulate a Cobb-Douglas type of production function for the transformation of agricultural inputs into output :

$$X_1 = a + b X_2 + c X_3 + dT + U \quad \ldots\ldots\ldots (3)$$

where X_1, X_2 and X_3 are the logs of output, un-irrigated and irrigated area respectively, all in physical units, T is time variable with origin in 1950-51, and U is random error (Cf. Tintner, 1952, PP 303-4). As data relating to water used for irrigation are not available, area irrigated is used as its proxy. Total area cultivated is thus divided into its two components: irrigated and un-irrigated area. Data for irrigated are available for 8 crops separately for the period covered by the study.

Total and multiple correlation coefficients are shown in table (3). The table shows that the correlation between production and area is statistically insignificant for rice, maize and barley. But it is significant for the other five crops at 5 per cent probability level which is used for testing all the coefficients. The coefficient and correlation between production and irrigation is also insignificant for three crops; rice, cotton and sugar-cane. In view of the fact that two of these crops require generally very high doses of water, the result is surprising. It might be due to the fixity of irrigated area under these crops over the period under study as the rate of growth of irrigated are under the three crops has been negligible as 0.25, 0.80 and 0.17 per cent per annum. It is as if the irrigated area under rice and sugar-cane were fixed. Besides, rice and sugar-cane crops are grown mainly in those regions of the state which receive adequate rainfall in the normal years. These two factors may explain the insignificance of the coefficient. But the correlation between production and time is insignificant only in case of rice and barley. Thus, time emerges as an important factor of growth in 6 out of 8 crops. For rice, all the three coefficients of correlation between production on the one hand, and area, irrigation and time on the other, are insignificant. The inter-correlation among the explanatory variables is significant in 14 and insignificant in 10 cases. Thus as is usually the case in production function studies, we have the problem of multi-collinearity in 6 out of the 8 crops.

The combined influence of area, irrigation and time in group of two and three is examined by means of multiple correlation coefficients. All the multiple correlation coefficients of second order, except two for rice, are statistically significant. A comparison of the values of the total correlation coefficients with the values of second order multiple

correltion coefficients show that the introduction of the second variable in the regression improves the proportion of the variation expressed by the regression appreciably in all the cases. But the replacement of area or irrigation in the regression by time variable does not improve the value of the multiple correlation coefficient of second order in the cases and even in those cases in which the values of the second order coefficients increase due to replacement of variable 2 or 3 of time in the regression, the increase in negligible. In fact, the results show that in case of wheat and pulses, it is irrigated area which is the most dominant factor in the growth or output whereas it is the unirrigated area which accounts forthe major share of the growth of output of rice, maize, cotton and sugar-cane. But in the case of gram and barley both irrigated the unirrigated area happen to be important factors of growth.

All the multiple correlation coefficients of third order are significant at 5 per cent probability level. The proportion of variation due to regression ranges from 46 to 91 per cent. But the introduction of the third variable into the regression raises the value of the coefficients of determination only marginally in most of the cases. Another point to be noted is that it is the introduction of time variable into the regression along with area and irrigation which raises the value of the coefficient of determination only negligibly except in case of rice, maize and cotton. Besides, the partial regression/correlation coefficients of second order attached to time variable are not only insignificant but they also have negative sign attached to them in 5 out of 8 cases.* Therefore, the time variable is dropped from the regression in the analysis of production relations.

The partial first order coefficients of regression of production on area and irrigation are tabulated below :

CROP b	Wheat	Rice	Maize	Barley	Gram	Cotton	Sugar Cane	Pulses
$b_{12.3}$	.3010	-.3408	-.1898	-1.7357	1.0095	1.0588	0.8632	-.1877
$b_{13.2}$	1.2825	1.6464	1.7707	13.9825	-1.6000	0.2432	-0.0044	3.2332
Sum	1.5835	1.3056	1.5809	12.2468	-0.5905	1.3020	0.8588	3.0455

* Kamiya obtained negative regression coefficients attached to labour in his study of paddy farms in Tokoku and Seinan districts of Japan due to the fixity of family labour engaged on these farms and the fixed size of the farms in Japan. Quoted by Heady, E.

The sign of the regression coefficients attached to area is negative for rice, maize, barley and pulses. This might be due to the fixity of un-irrigated area under these crops during the period studied. In fact, even the total area under two of these crops had remained stagnant and the area under barley has declined. The sign of the regression coefficient attached to the irrigated area is negative only in case of gram and sugar cane. While negative sign of the regression coefficient attached to the irrigated area under sugar-cane can be explained in terms of the fixity of irrigation over time as the irrigated are under sugar-cane has expanded at the negligible rate of 0.17 per cent per annum, the negative sign of the regression coefficient attached to irrigated area for gram can not be explained in similar terms as the rate of growth of irrigated area under gram has been 2.72 per cent per annum all through the period covered by the study.

An important point to be noted is that the numerical value of the elasticity of output with respect to irrigation is several times the elasticity of output with respect to unirrigated are for all crops except cotton, gram and sugar-cane. Another feature of the coefficients is that their sum is greater than unity in all cases except gram and sugar-cane. It implies that there are increasing returns to scale with respect tothe inputs of irrigated and un-irrigated area. But one can not be very sure about it as almost all other important inputs of agricultural production have been exluded from the regression (See, Ref. 2,).69).

New Technology and Production Relations :

The success of the modern agricultural technology hinges largely upon the ever increasing use of high yielding crop varieties. But the use of high yielding crop varieties becomes effective only if all modern inputs are used as a package. The package involves mainly the use of improved seeds, chemical fertilizers, irrigation water and pecticides as essential inputs (Mudhar,).120). High yielding seed varieties mainly of wheat, paddy, maize, bajra, and jowar have been introduced in the state of Madhya Pradesh since 1966-67. If we take all the modern inputs of agricultural production into account, their number will be quite large. In view of the fact that we have only 8 observations relating to the use of inputs like high yielding seed varieties, fertilizers, irrigation and pecticides etc. from 1966-67 to 1973-74, would be advisable to restrict the number of variables in the regression to study production relations. For time series data, fertilizers and high yielding seed varieties along with area and irrigation have been taken as explanatory variables. But we have many

more observations for cross section data for which some other variables have also been taken as explanatory variables.

The growth of production and the use of modern inputs has not been uniform for all the five crops. Compound annual growth rates of output and the found inputs of these crops over the period from 1966-67 to 1973-74 are shown in table (4). The table shows that the production of paddy has increased on an average by 1.5 per cent per annum. This has resulted from the growth of area, irrigation, high yielding seeds varieties and fertilizers. The use of HYV seeds has increased at a very high rate of 48.4 per cent per annum but the use of fertilizers has increased only at a rate of 5.7 per cent per annum. Area and irrigation also show nominal growth at rates of 1.1 and 0.2 per cent per annum respectively. The disparity between the growth rates of different inputs seems to have been the result of the fact that whereas the HYV seeds were introduced for the first time in 1966-67, the otherinputs like fertilizers and irrigation were already in use for quite some time. Consequently, the growth rates for the supporting inputs are much lower than that of the HYV seeds. Production of wheat has increased at 4.7 per cent per annum while the use of HYV seeds and fertiliser increased at very high rate of 47.8 and 42.2 per cent per annum. In case of wheat, the use of HYV seeds and fertilizers have increased at, more or less, similar rates, Irrigated area also show a comparatively high annual growth rate of 9.6 per cent. But the highest rate of growth of output is for bajra. For bajra also, the use of HYV seeds and fertilisers increases at very high rates of 27 and 61 per cent per annum. But the disparity between the growth of these two inputs for bajra production also is quite substantial. Both maize and jowar show negative growth of output during the same period, Negative growth of output of maize might have been the result of the negative growth of irrigation and fertilizers whereas the production of jowar has decreased despite the growth of use of HYV seeds and fertilizers. The above analysis shows that the use of HYV seeds and other supporting inputs like fertilizers has not increased at rates commensurate with each other except in case of wheat. The growth of irrigation has also lagged behind that of HYV seeds and fertilizers. The new agricultural technology has been so far introduced mainly in those areas which have a certain minimum amount of assured irrigational facilities. This large base besides other factors might explain the slow growth of irrigation in comparison to HYV seeds and fertilisers.

Analysis of Time-Series Data :

Cobb-Dougles production function has been fitted to the data for the years from 1951 to 1974 by least square method. The estimated equations are given below :

(Wheat) $X_1 = 94.159 + 0.4687\ X_2 - 3.6432\ X_3 + 0.0893X_4 + 0.6126X_5$
(R = .9437)

(Paddy) $X_1 = -2200.25 - 0.0188\ X_2 + 78.4856\ X_3 - 0.0851X_4 - 0.3674X_5$ (R = .8094)

(Maize) $X_1 = -68.20 - 0.3908X_2 + 4.2059X_3 + 0.0219X_4 - 0.1397X_5$
(R = .5710)

(Bajra) $X_1 = -37.91 + 2.5647X_2 - 0.2778\ X_4 + 0.4067\ X_5$ (R=.8472)

(Jowar) $X_1 = 1106.37 - 40.3850X_2 - 0.0838\ X_4 + 0.0887X_5$
(R = .8038)

where X_1 is output, X_2 is irrigated area,* X_3 is unirrigated area,* X_4 stands for HYV seeds and X_5 denotes fertilizers, all variables are measured in logarithms.

The coefficient of multiple correlation is significant in case of wheat and it is insignificant for all other crops even though its value is greater than 0.8 for all crops except maize. The partial regression coefficient attached to irrigated area is negative both in case of paddy and maize. It is not surprising in view of the fact that irrigation has grown negatively in case of maize while its rate of growth for paddy has been very tardy. But the partial regression coefficient attached to unirrigated area is negative only in case of wheat. The coefficient attached to HYV seeds is negative in case of paddy, bajra and jowar. The negative sign of the coefficient is surprising in view of the fact that the annual compound growth rate of the use of HYV seeds for all the three crops has been very high. The coefficient attached to fertilizers is also negative in case of paddy and maize. It might be due to the negative growth of the use of fertilizers in maize production of paddy. In fact, the reduced supplies of fertilisers and the steep rise in their prices towards the last years covered by the study have greatly affected the use of fertilizers in the state. The partial regression coefficient

*X_2 stands for total area (both irrigated and unirrigated) under jowar and bajra for which the data relating to irrigated area are not available for all the year covered by the study.

attached to total area is negative in case of jowar for which the total area under cultivation has grown negatively. Thus, we find that 3 out of 4 partial regression coefficients in case of paddy, 2 out of 3 coefficients in case of jowar and 2 out of 4 coefficients in case of maize have negative signs attached to them. In-puts of irrigated area, HYV seeds and fertilizers in case of what, unirrigated area in case of paddy, unirrigated area and HYV seeds in the production of maize, total area and fertilizers in the production of bajra and fertilizers in case of jowar make a positive contribution to their respective output.

An important point to be noted is that the sum of the regression coefficients is positive and greater than unity in case of paddy, maize and bajra while the sum is negative for wheat and jowar. Negative contribution of unirrigated area to the output of wheat makes the total returns negative. Similarly, negative contribution of area and HYV seeds to the output of jowar makes the total returns to scale negative. But. the increasing returns to scale in the production of paddy, maize and bajra are indicated.

The marginal productivities of the factor inputs have been calculated at their respective geometric means which are given below :-

Crop/ Input	X_2	X_3	X_4	X_5
Wheat	0.577	-3.527	0.140	0.475
Paddy	-0.023	76.660	-0.128	-0.288
Maize	-2.310	4.080	0.043	-0.179
Bajra	2.340		-0.774	0.343
Jowar	-1666.79		-0.177	0.089

Some of the elasticities or the marginal productivities of factor inputs are negative. It is hardly conceivable that the total output would decrease as a result of an increase in the quantities of any one of the essential inputs. But only two of the negative coefficients are statistically significant. In case of maize, output, irrigation and fertilizers used all grow negatively while hyv seeds grow positively. Thus the violation of the use of modern inputs in the recommended package may account for the negative productivities of irrigation and fertilizers. Similarly, the negative growth of irrigation in case of bajra might be responsible for the negative productivity of one of the inputs while in case of jowar, the negative growth

of both output and irrigation may similarly explain the odd results. But in case of wheat, the absence of hyv seeds suitable for dry farming and the unsuitability of the unirrigated lands for the existent technology may account for the odd results. But some of the odd results might also be due to the limited number of observations from which we have to estimate the functions.

Production Functions estimated from Cross-Section Data :

Cross section data relate to the year 1973-74 and the district is the unit to which it is related. As all the crops are not cultivated in each of the 43 districts of the state, the number of observations differ from crop to crop. Districts where new crop varieties and other complementary inputs for the production of a crop(s) has not been introduced so far have also been lect out of the analysis. The following are the estimated equations of the production functions :

(Wheat) $X_1 = 0.923 - 1.733 X_2 + 0.715 X_3 + 0.241 X_4 + 0.684 X_5$ (R=.9694*)

(Paddy) $X_1 = 2.139 + 1.632 X_2 + 0.521 X_3 + 0.356 X_4 + 0.066 X_5$ (R=.9618)

(Maize) $X_1 = 1.237 + 0.977 X_2 - 0.199 X_3 + 0.106 X_4 + 0.395 X_5$ (R=.9995)

(Jowar) $X_1 = 1.141 + 0.185 X_2 + 0.152 X_3 + 0.001 X_4 + 0.049 X_5$ (R=.5813)

where X_1 denotes output, X_2 is irrigated area, X_3 stands for unirrigated area, X_4 is area under HYV seeds and X_5 is the amount of chemical fertilizers used, all in logarithmic units.*

The marginal productivities of the factor inputs are as follows :

Crop/ Input	X_2	X_3	X_4	X_5
Wheat	-0.816	0.259	0.111	0.308
Paddy	2.366	0.321	0.330	0.048
Maize	0.464	-0.196	0.051	1.130
Jowar	0.138	0.219	0.0006	0.077

*Tractors were also tried as one more explanatory variable. But the increase in the value of the correlation coefficient (multiple) is nearly zero and the presence of the additional variable makes the regression coefficients attached to other explanatory variables negative in two crops. Besides, the partial regression coefficient attached to tractors themselves is negative in all the cases. Therefore, the results are not reported here.

All the four coefficients of multiple correlation are statistically significant whereas for the production functions estimated from time-series data the coefficient for wheat crop alone is significant. Naturally, the values of all the coefficients, except one for jowar, are greater than the calues of the coefficients for the functions estimated from time-series data. In view of the above results, it seems thatthe insignificance of the coefficients of multiple correlation for time-series data is due to the limited number of observations in relation to the number of explanatory variables included in the function. The partial regression coefficient (and therefore, the marginaly productivities) attached to irrigation in the production of wheat and that attached to HYV seeds in case of maize alone are negative. The marginal productivities estimated from the production functions indicate the direction in which the pattern of allocating the scarce inputs should change in order to achieve optimum production. For example, fertilizers have the highest marginal yield in the production of maize while irrigation yields the best results in the production of paddy. Therefore, the diversion of fertilizers from other crops to maize and the transfer of irrigated area from other crops to paddy is likely to raise the over all production in the state.

The results indicate that as in case of time series analysis, the sum of the partial regression coefficients for wheat crop is negative for the cross section analysis also. It means that the returns to scale in case of wheat are negative. The sum of the partial regression coefficients for Jowar is positive but less than one. Whereas the time-series analysis indicated negative returns to scale for Jowar, cross section analysis indicates positive but diminishing returns to scale. For paddy and maize, the cross-section results, like the time-series analysis, show increasing returns to scale.

Conclusions and Resume :

Results of the study show that agricultural production in the state of Madhya Pradesh has increased slowly but steadily ever since 1950-51. While the state achieved faster development than that in the country as a whole in the production of course grains and pulses, it has lagged behind the country in the production of wheat, paddy, oil-seeds and other commercial crops. Another important point is that the growth of production of several crops has depended more upon the growth of area than the growth of yield per hectare.

Irrigated area emerges as an important factor of growth of output in stepwise regression analysis. The sum of regression coefficients attached to irrigated and unirrigated area under all the crops except gram and sugar-cane indicate increasing returns to scale.

There seems to be a lack of package approach in the use of modern inputs like HYV seeds, chemical fertilizers and irrigation as a result of which the use of these inputs in the production of most of the crops increases at vastly different rates. Increasing returns to scale obtain in the production of paddy, maize and bajra while the total returns to scale are negative in the production of wheat and jowar. But the results obtained from cross-section data seems to be better than those obtained from time-series data. The estimated marginal productivities of the factory inputs indicate the desirability of reallocation of the inputs among the competing crops for obtaining optimum production. These results indicate negative returns in the production of wheat, increasing returns in the production of paddy and decreasing returns in the production of maize and jowar.

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Appendix

Data Sources and Assumptions :-

All data have been taken from 'agricultural Statistics' 1969-70, 1970-71, 71-72, 72-73, 73-74, Directorate of Agriculture, Bhopal and 'Agriculture and Animal Husbandry' part I, 1967-68, Directorate of Economics and Statistics, Bhopal. Land area is measured in thousand hectares and output is measured in thousand tone. All other inputs are also measured in physical units. Crop-wise use of fertilisers is not available. Therefore, the total amount of fertilizers consumed in the state in a year is allocated to different crops in proportion to the area covered by the High yielding Seeds Varieties (HYV)/ area irrigated. Other methods of allocating fertilisers among different crops were also tried but the results were not satisfactory. One such method which was tried is to allocate 50/60 per cent of the recommended doze of fertiliser for each major crop. But the sum total of fertilisers thus allocated to all major crops far exceeds the amount of the total fertilisers consumed in the State. Water used for irrigation is also not available. Therefore, area irrigated under each crop is assumed to measure the degree of irrigation.

Table : 1

Estimated Growth Curves of Area, Production and Productivity

Crop/ Variable	Area		Production		Productivity	
	Constant	b	Constant	b	Constant	b
Rice	3.5719	0.0034	3.3568	0.0072	2.7954	0.0042
Bajra	2.2266	0.0051	1.8059	0.0182	2.5125	0.0180
Maize	2.5549	0.0100	1.7166	0.0562	2.6589	0.0164
Wheat	3.3629	0.0071	3.0188	0.0168	2.6791	0.0093
Barley	2.2270	-0.0002	2.0204	0.0075	2.6512	0.0158
Gram	3.1313	0.0037	2.8069	0.0078	2.6741	0.0040
Jowar	3.2702	0.0037	2.8024	0.0218	2.6291	0.0098
Kodokutki	3.0781	0.0030	2.3509	0.0060	2.2733	0.0030
Others	2.2596	0.0126	1.7427	0.0094	1.7557	0.0038
Cereals & Millets Total	2.9744	0.0091	3.6532	0.0132	2.6479	0.0091
Tur/Rahar	2.4679	0.0112	2.3390	0.0075	2.8112	0.0002
Lakh	2.7364	0.0051	2.1831	0.0115	1.2445	0.0065
Urad	2.6863	0.0062	2.0594	0.0096	2.3288	0.0020
Moong/Moth	2.2099	0.0079	1.5393	0.0147	2.3696	0.0010
Massoor	2.3055	0.0106	1.7684	0.0098	2.5694	0.0007
Other Pulses	2.2269	0.0051	1.4522	0.0305	2.2364	0.0236
Total Pulses	3.5408	0.0052	2.9750	0.0152	2.6099	0.0025
Total Food Grains/Crops	4.1511	0.0046	3.9809	0.0066	2.2273	0.0565
Groundnut	2.7329	-0.0026	1.9806	0.0279	2.5119	0.0075
Castorseed	0.9300	-0.0112	1.5452	0.0144	2.4907	0.0020
Sesamum	2.6176	0.0048	1.9190	-0.0111	2.3179	-0.0073
Rape/Mustard	2.0837	0.0067	1.8226	0.0090	2.5420	-0.0008
Lin-seeds	2.7125	0.0038	1.9971	0.0065	2.2764	0.0030
Others	2.2585	0.0103	1.2555	0.0189	1.9669	0.0115
Total oil-Seeds	3.0325	0.0167	2.5846	0.0094	2.0718	0.0029
Potato	0.8394	0.0184	1.426	0.0439	0.6379	0.0076
Mesta	0.5944	0.0284	1.2837	-0.0006	0.6917	-0.0262
Sunhemp	1.6328	-0.0109	1.9740	-0.0168	0.2599	0.0006
Tubacco	0.8377	-0.0221	0.5772	-0.0226	0.6371	0.0076
Cotton	2.8550	0.0015	2.6001	-0.0063	2.3828	-0.0017
Sugar-Cane	1.5498	0.0097	1.9608	0.0099	3.4247	-0.0005

Table : 2

Percentage Share of Madhya Pradesh in All India Production

Crop/Year	1951	1974
Rice	10.58	8.09
Jowar	8.49	12.86
Bajra	1.8	3.02
Maize	7.93	9.16
Wheat	16.59	11.78
Total Cereals & Millets	6.99	9.03
Gram	15.44	24.36
Total Pulses	7.47	19.85
Total Food Grains	7.10	10.05
Ground-Nut	3.19	3.72
Major Oil-Seeds	6.95	6.29
Cotton	1.29	0.89

Table : 3

Correlation Coefficients :
Multiple Correlation Coefficients :

Crops	$R_{1.23}$	$R^2_{1.23}$	$R_{1.24}$	$R^2_{1.24}$	$R_{1.34}$	$R^2_{1.34}$	$R_{1.234}$	$R^2_{1.234}$
Wheat	.8470*	.7174	.7142*	.5101	.8718*	.7594	.8726*	.7614
Rice	.4398	.1934	.6235*	.3887	.3725	.1388	.6011*	.4639
Maize	.6419*	.4121	.8226*	.6766	.7983*	.6373	.8252*	.6869
Barley	.9126*	.8327	.4954*	.2454	.8069*	.6511	.9540*	.9101
Gram	.7318*	.5356	.6084*	.3702	.6405*	.4102	.7547*	.5695
Pulses	.7382*	.5449	.7860*	.6178	.8480*	.7191	.9126*	.8329
Cotton	.5983*	.3579	.8456*	.7150	.5466*	.2987	.9362*	.8764
Sugar-Cane	.9383*	.8804	.9410*	.8855	.5685*	.3231	.9418*	.8870

Table of Total Correlation Coefficients :

Crop	Variable	1	2	3	4
Wheat	1	1	.0337*	.7384*	.7104*
	2		1	.3745*	.9305*
	3			1	.4241*
	4				1
Rice	1	1	.0204	.3396	.3721
	2		1	.6707*	.8215*
	3			1	.9309*
Maize	1	1	-.2473	.5661*	.7910*
	2		1	.0954	-.0272
	3			1	.7981*
	4				1
Barley	1	1	-.3676	.7583*	.3724
	2		1	.1746	-.1157
	3			1	.1303
	4				1
Gram	1	1	.4184*	.5768*	.5576*
	2		1	.4865*	.9207*
	3			1	.5702*
	4				1

Continued

Table 3 continued

Crop	Variable	1	2	3	4
All Pulses	1	1	0.5389*	.7251*	.7169*
	2		1	.8452*	.9239*
	3			1	.8894*
	4				1
Cotton	1	1	.4916*	.3106	-.4609*
	2		1	-.0607	.6757*
	3			1	-.0396
	4				1
Sugar-Cane	1	1	.9369*	.2301	.5644*
	2		1	.2974	.6713*
	3			1	.2924
	4				1

* Coefficients Statistically significant at 5 per cent probability level. X_1 is output, X_2 denotes un-irrigated area, X_3 represents irrigated area and X_4 is time variable.

Table : 4

Compound Annual Growth Rates from 1966-67 to 1973-74

Crop/ Variate	Output	Irrigation	Un-irrigated Area	HYV Seeds	Fertilizers
Paddy	1.50	1.10	0.90	48.40	5.17
Wheat	4.70	9.60	1.80	47.80	4.20
Maize	-6.58	-3.30	0.70	0.80	-30.60
Bajra	5.30	-3.15		27.30	61.10
Jowar	-7.93	-2.39		51.10	99.50